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Factors Affecting the Outcome of External Dacryocystorhinostomy in Al-Thawra Hospital in Sana'a – Yemen.

A thesis submitted in fulfillment for the requirements of the Degree of M. D in Ophthalmology

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{ قَالُوا سبحانك لا علْم لَنا إِلا ما علمتنا
إِنك أَنت الْعليم الْحكيم }

صدق الله العظيم
(البقرة:32)

CONTENTS

Dedication

To my parents for their never- ending support and everlasting care at every stage of my life.

Acknowledgment

I would like to express my deepest gratitude and appreciation to ***Dr. Abdulla Salim*** *(Assoc. Professor of Ophthalmology) for his encouragement and support during the conduction of this work.*

Special deep thanks for ***Dr. Elfatih Fadl*** *(Assoc. Professor of Ophthalmology) for his support, precious advices and guidance in this work.*

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List of Abbreviations

AEPS: Acquired external punctual stenosis.

AMT: Amniotic membrane transplantation.

CCO: Common Canalicular obstruction.

CDCR: Conjunctivo-dacryocystorhinostomy

CT: Computed tomography.

DCG: Dacryocystography.

DCP: Dacryo-Plasty.

DCR: Dacryocystorhinostomy.

DCT: Dacryocystectomy.

DDT: Dye Disappearance Test.

ENL-DCR: Endonasal laser assisted dacryocystorhinostomy.

Ext-DCR: External dacryocystorhinostomy.

FCT: Fluorescein Clearance Test.

G A : General anesthesia .

HO-YAG L: Holmium-YAG laser.

IDU: Idoxuridine.

KTP L: Potassium – titanyl – phosphate laser.

MMC: Mitomyein C .

MRSA: Methicillin resistant staphylococcus aurius.

MRT: Micro –Reflux Test.

Nd-YAG L: Neodymium YAG laser.

NLD: Nasolacrimal duct.

NLDO: Nasolacrimal duct obstruction.

PANDO: Primary acquired nasolacrimal duct obstruction.

SANDO: Secondary acquired nasolacrimal duct obstruction.

SR: Success rate.

Abstract

Factors affecting the outcome of external dacryocystorhinostomy in AL-Thawra Hospital in Sana'a – Yemen

Objectives:

To evaluate the outcome of external DCR in order to determine the factors affecting its results, so as to improve its outcome.

Design:

Prospective, non- comparative, hospital- based study design.

Place and duration:

AL-Thawra Hospital Sana'a – Yemen from February 2004 to October 2008.

Methods:

This study included one hundred twenty patients who had been diagnosed as having nasolacrimal drainage obstruction and booked for surgery in the Department of Ophthalmology at AL-Thawra Hospital. Ext-DCR was done by more than one surgeon. The surgical procedures were exactly the same in all patients, except that seventeen of them recived subcutaneous injection of adrenaline and xylocaine at the site of skin incision and nasal packing with adrenaline and xylocaine according to the

permission of the anaesthetist. Silicone intubation was done for all patients.

The patients assessed on the second day, one week, two months and six months postoperatively.

The results of Ext-DCR surgeries were evaluated by objective findings such as irrigation and fluorescin dye disappearance test and subjective symptoms by asking the patients about the condition of tearing improvement.

Results:

Our study showed that the age of the patients ranged from 8 to 70 years, most of them belonged to the middle age group with the mean age of 31.5 years and female predominance. The indications for Ext-DCR were chronic dacryocystitis, congenital nasolacrimal duct obstruction, primary acquired nasolacrimal duct obstruction, previous failure DCR and trauma respectively. The success rate was 96% and the complications recorded were not dangerous.

Conclusion:

External DCR combined with silicone intubation shows a high success rate in our study which is consistent with what was mentioned in the literature. The lowest success rate of Ext-DCR was in those patients with trauma while patients with revision of previous failed DCR had the highest success rate.

External DCR has minimum complications in the form of mild to moderate intra-operative bleeding, wound infection and skin scarring.

***Recommendations* :**

proper pre-operative assessment for the patients in order to see if there is no contra-indications for the subcutaneous injection of adrenaline xylocaine at the site of the operation and nasal packing with adrenaline and xylocaine in order to reduce the amount of intra-operative bleeding.

The osteotomy size should not be less than 1.5cm x 1.5cm .

ENT examination should be done when needed .

ملخص الرسالة باللغة العربية

العوامل التي تؤثر على نتائج توصيل مجرى الدموع من الطريق الخارجي في مستشفى الثورة في صنعاء – اليمن

أهداف الدراسة :

تقييم نتائج عمليات توصيل مجرى الدموع من الطريق الخارجي ومعرفة العوامل المؤديه إلى نجاح أو فشل هذا النوع من العمليات الجراحيه وذلك لتحسين نتائج هذه العمليات .

تصميم الدراسه :

دراسه آنيه غير قائمه على المقارنه ، مبنيه على إجرئها فى المستشفى .

مكان ومدة الدراسه :

مستشفى الثوره فى صنعاء عاصمة اليمن وذلك خلال الفترة من فبراير 2004 إلى أكتوبر 2008 .

طريقة الدراسه :

أُجريت هذه الدراسة على مائة وعشرون مريضاً من الذين يشكون من زيادة في تدفق الدموع من العين وتم تشخيصهم على أنهم يعانون من انسداد في المجرى الدمعي للعين, ُوسجلوا للعمليات في قسم العيون بمستشفى الثوره .

تم إجرأ العمليات بأكثر من جراح وكانت خطوات العمليه موحده عند جميع المرضى فيما عدا سبعة عشرة منهم تم حقنهم بمادتي الأدرينالين مع الزيلوكأين تحت الجلد عند فتحة العمليه وأيضاً كانت حشوة الأنف مشبعه بتلك المواد طبقاً لموافقة طبيب التخدير او رفضه .

تم فحص المرضى في اليوم الثاني للعمليه وبعد إسبوع وبعد شهرين ثم بعد ستة أشهر.

قُيمت نتائج العمليات بواسطة تروية مجاري الدموع وتجربة إختفاء مادة الفلورسين من العين عند وضع نقط منها في الملتحمه تحت الجفن ألاسفل ، وايضَا بسؤال المريض عن تحسن حالته وإختفاء أعراض المرض منه .

نتائج الدراسه :

أظهرت الدراسه أن أعمار المرضى كانت تتراوح بين 8 سنوات إلى 70 سنة ومتوسط العمر كان 31.5 وقد كان عدد الإناث ما يقرب من ضعف ونصف عدد الذكور بنسبة 2.5 : 1.

تبين من الدراسة الإحصائية أيضاً أن السبب الرئيسي لإجراء العملية هو الإلتهاب المزمن للكيس الدمعي حيث أن نسبة المرضى الذين يعانون من ذلك كانت (67.5%).

بعد ذلك يأتي الانسداد الخلقي للقناة الدمعية الأنفية ثم الانسداد المكتسب للقناة الدمعية الأنفية نتيجة لسبب غير معروف ويأتي بعد ذلك العمليات المعاده لمرضى عملت لهم تلك العمليه فى السابق وتم فشلها وأخيراً يأتي الانسداد نتيجة إصابات سابقة في الوجه عند منطقة القنوات الدمعية.

خلاصة الدراسه :

عمليات توصيل مجرى الدموع من الطريق الخارجي مصحوبه بإدخال انبوب من السيلكون في مجرى الدموع لها نسبة نجاح عاليه فى هذه الدراسه والتي تتلأم مع ماقيل في المطبوعات السابقه حيث وصلت نسبة النجاح إلى 96% وقد كانت نسبة النجاح الأعلى عندما كان السبب هو عملية سابقة فاشلة لتوصيل مجرى الدموع وأيضاً في العمليات التي أجريت للمصابين بالانسداد المكتسب للقناة الدمعية الأنفية لسبب غير معروف حيث وصلت نسبة النجاح في كلاهما إلى 100% بينما كانت نسبة النجاح متدنيه عند المرضى الذين يعانون من الانسداد في مجرى الدموع نتيجة إصابة سابقة في الوجه حيث كانت نسبة النجاح 60% فقط.

أما مضاعفات العملية فكانت عباره عن نزف دموي أثناء العملية حيث كان النزيف يتراوح بين الخفيف والمتوسط عند معظم الحالات. أما المضاعفات النادرة فهي عبارة عن التهاب موضع العملية وندب في الجلد بعد التئام موضع الجراحه.

التوصيات:

أوصت الدراسة بضرورة الدقة في فحص المريض جيداً قبل العملية، لمعرفة أنه لاتوجد أي موانع أو خطورة من إعطأ المريض مادتي الإدرينالليين والزيلوكأين وذلك للتخفيف من كمية النزف أثناء إجراء العملية.

أوصت الدراسه ايضاً بأن لايقل حجم فتحة العظم التي يتم عملها للتوصيل بين الكيس الدمعي وتجويف الانف عن 1.5سم × 1,5سم .

كما أوصت الدراسة بضرورة فحص المريض من قبل أخصائي الانف والاذن والحنجره عند الحاجه إلى ذلك .

List of tables

List of figures

Chapter one

1 – 1 - INTRODUCTION

Dacryocystorhinostomy (DCR) is a surgical method for treatment of the lacrimal excretory system obstructon. Obstruction of the passage of tears from the puncti through canaliculi, lacrimal sac and finally the nasolacrimal duct down to the nose can lead to stagnation of tear in the point before the obstruction , with continuous tearing and the resultant infection with continuous pus discharge into the eye , which may lead to ocular and peri-ocular infections with the possible sequelae of vision –or even – life threatening complications.[1]

When this infection is established in the lacrimal excretory parts, this leads usually to the destruction and fibrosis of the thin delicate canal which penetrates the tissue (including the bone) to excrete tears in the inferior part of the lateral wall of the nose , at this point there is no solution other than creating a new window through those tissues to permit tears to be excreted in the nose again.[2]

Since the introduction of external DCR subsequent modifications have ensured a high success rate and it remains the gold standard for treating of epiphora caused by nasolacrimal duct obstruction.[3]

This study will be conducted in AL-Thawra Teaching Hospital in Sana'a the capital of Yemen. That hospital is the main referral hospital in the country. It receives a large number of patients with nasolacrimal duct obstruction. It was noted that

many operations of Ext-DCR were performed for patients suffering from nasolacrimal duct obstruction .

Ext-DCR is the only method of treatment done in this hospital. Statistical year-book of the hospital shows that the number of Ext-DCR done at the hospital in 2005 was 60 cases , while in 2006 the number was 67 cases and in 2007 the number was 80 cases . At present there is no recorded information on the results of this treatment nor the factors that influence the outcome of this operation. This study is done to investigate the outcome and results of the management of these cases.

Country profile :

The Republic of Yemen is situated in the South-Western corner of the Arabian peninsula between latitudes 12-20 north of the Equator and longitudes 14-54 east of Greenitch.

Topographically, Yemen could be divided to five regions: Mountainous , Plateaus , Coastal , Desert and Islands .

Population : 20 , 900, 532 .

Sex :

Male 10 , 661, 838

Female 10 , 238 ,694 .

Life expectancy : 59 . 2

Crude death rate : 11.3 / 1000

Infant mortality rate : 75.3 / 1000

Public health facilities :

Hospitals: 363

Health centers: 759

Primary health care units: 2302

Data above is from the statistical Year Book 2006, Ministry of Planning and International Cooperation Central Statistical Organization (CSO), Republic of Yemen.

1 – 2 - HISTORICAL BACKGROUND

Dacryocystorhinostomy (DCR) is the treatment of choice for patients with chronic stenosis and obstruction of the nasolacrimal duct. It means creation of a new bony opening between the lacrimal sac and the nasal cavity to be an alternate to the original blocked lacrimal system.[4,5] It has the following methods:

External DCR in which the lacrimal sac is approached from outside via a short skin incision and internal DCR in which the lacrimal sac is approached via inside the nose.[6] The internal one has two procedures : internal DCR with the use of endoscopy alone and internal DCR with the use of endoscopy and laser to create a rhinostomy.[6,7,8,9,10]

External dacryocytorhinostomy (EXT-DCR) was first described by Toti in 1904, his technique has the same idea of the modern EXT-DCR except that he used to remove the whole nasal mucosa beyond the bony window, there were only a 10-15% success rate (SR) .[11]

This low SR is proposed to be due to the tissue fibrosis which occurred in the bony ostium formed which leads to its blockage again.[12] Before that , a lot of solutions have been implemented aiming for resolution of epiphora . In 1713 Anel recommended probing for the naso-lacrimal passage followed by irrigation . About 1724 , Wool House was the first who try to make a short circuit from the lacrimal sac to the nose by

excising the sac, piercing the lacrimal bone with a trocar and inserting a drain through this opening . In 1851 , Bowman was the first one shows that the puncti and canaliculi could be dilated for the passage of the NLD probes of graduated sizes , which bear his name . In 1868 , Berlin excised the sac only, and named his operation as dacryocystectomy (DCT) . [11]

Blascovics in 1912 , Khunt in 1914 and Ohm in 1920 tried to modify Toti Procedure by uniting the canaliculi with the nasal mucosa , which didn't find any acceptance . [5]

Dupuy Dutemps and Bourguet introduced anastomosis of the flaps of the lacrimal sac and nasal mucosa instead of removing them , with this addition a tunnel which is formed facilitate the tear drainage to the nasal cavity and reduced the fibrosis rate where a good results were achieved . [5]

Suturing of nasal mucosa with the lacrimal sac was suggested by Ohm at 1926.[12] ILIFF suggested placing a rubber catheter into the sac.[13] In 1952 Summoskill , etal described the intubation a rubber hollow tube from the puncti up to the nasal cavity down to relieve an upper canalicular obstruction.[14] Later this rubber tube is substituted by a silicone one which aims to reduce the foreign body reaction to that tube . Routine use of silicone tube is a useful adjunct to external DCR procedure and was advocated by Older.[15] More recently it is advised not to leave the tube in for more than 3 months.[16] Another very important modification is to increase the osteotomy opening size (minimum size suggested is 15 x 15 mm), so as to facilitate the

mobility of the mucosal flap and to minimize the failure rate by reducing the chance of closure by adhesion.[16,17,18]

Various modification have been made , but basic procedure is still the same.[12] With those many modifications External DCR operation has reached a success rate of 90-100%.[4,17]

The endonasal approach was first introduced in 1893 by Caldwell, but it was inherently limited by poor visibility of endonasal anatomy during surgery. [19] The introduction of high-resolution fibreoptic Endoscopes in the late 1980s enabled adequate visualization of the nasal cavities, and permitted minimally invasive surgery, under local anaesthesia, avoiding visible facial scarring.[20,21] Endonasal dacryocystorhinostomy (ENL-DCR) can be performed either entirely surgically or with the assistance of laser to create the fistula . [22]

Massaro, Gonnering and Haris[23,24] were the first who describe the endonasal dacryocystorhinostomy (ENL-DCR), using Argon laser for the creation of the DCR fistula. Since then Carbon dioxide (CO2), Holmium-YAG (Ho-YAG), Neodymium-YAG (Nd-YAG), and Potassium-Titanyl-Phosphate (KTP) laser system have been employed in an attempt to identify the optimal delivery system that would achieve sufficient bone ablation with effective haemostasis.[25]

1 – 3 - LITERATURE REVIEW

Here the anatomy, physiology, pathology, diagnosis, and treatment would be revised, that would emphasize clinically relevant material to aid in understanding, diagnosing, and treating lacrimal disorders.

1 – 3 – 1 - ANATOMY OF THE LACRIMAL SYSTEM

The lacrimal system is made up of a secretary apparatus (the major lacrimal gland and the accessory glands) and the excretory apparatus (the eyelids, lacrimal puncti, canaliculi, lacrimal sac, and the nasolacrimal duct).[7]

A - THE SECRETORY APPARATUS

There are two main groups of exocrine lacrimal glands concerned with the formation of tears, the lacrimal gland proper and the accessory lacrimal glands.

The lacrimal gland proper located in the superior lateral quadrant of the orbit within the lacrimal gland fossa which is formed by the orbital plate of the frontal bone in the anterolateral part of the roof of the orbit. The gland is divided in its anterior aspect by the lateral horn of aponeurosis of the levator muscle into two parts-the superior orbital and the

inferior palpebral- which are continuous with each other posteiorly.[26]

The accessory exocrine glands of Krause and Wolfring are located in the superior fornix and above the superior border of the tarsus, respectively.

There are about 12 ducts collecting the secretion of the whole gland,4 to 5 coming from the orbital lobe and 6 to 8 from the palpebral lobe .These ducts open in the conjunctival sac 4 to 5 mm above the upper border of the tarsus .The ducts from the orbital portion traverse the palpebral part.27

Aqueous lacrimal secretion is divided into basal low-level secretion and reflex secretion .The tear film composition is as follows:

- Goblet cells within the conjunctiva provide the inner layer of the tear film by secreting mucin, which allows for even distribution of the tear film over the ocular surface.
- The main & the accessory lacrimal glands secretion form the intermediate aqueous layer of the tear film.
- Meibomian glands produce the oily outer layer of the tear film, which reduce the evaporation of the underlying aqueous layer.[28,29,30]

B - THE EXCRETORY APPARATUS

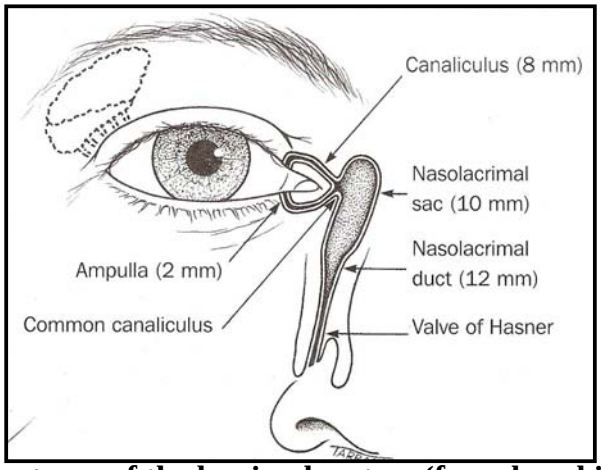
The lacrimal drainage system is a continuous and complex membranous channel whose function is dependent on the

interaction of anatomy and physiology. It includes, puncta, canaliculi, lacrimal sac, and nasolacrimal duct. .[31]

Some tear fluid is lost by evaporation and some by reabsorption through conjunctival tissue, but approximately 75% is passed through the nasolacrimal system.[32]

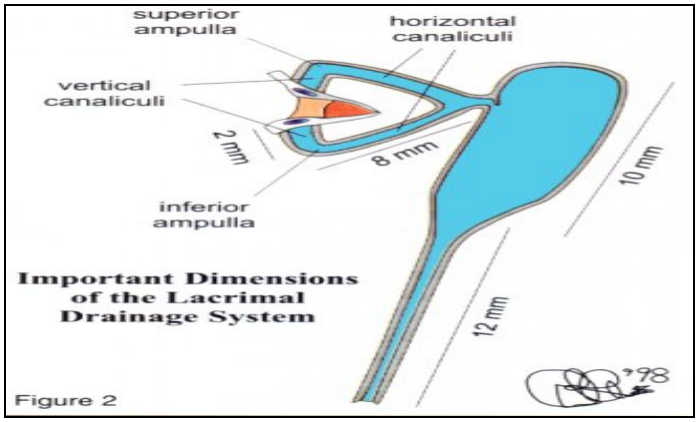
The lacrimal punctum is located in a slight tissue elevation, the lacrimal papilla, at the junction of the lacrimal and ciliary portions of the eye lid margin. Both upper and lower lids have a punctum.

The upper and lower puncti that provide the entrance to the lacrimal excretory system should be found slightly inverted against the globe in the tear lake. Each punctum expands into its respective ampulla, which is 2 mm in length and oriented perpendicular to the lid margin. The canaliculi are each 8 -12 mm long .In approximately 90 % of individuals, the canaliculi combine to form single common canaliculus that enters the lateral wall of the lacrimal sac.[33,34]



Anatomy of the lacrimal system (from kanski): clinical ophthalmology,[35]

A fold of mucosa ,called the valve of Rosenmuler, has traditionally been described as the structure that prevent tear reflux from the sac back into the canaliculi with operation of tear pump. With total nasolacrimal duct obstruction, the retained mucoid or purulent contents of the sac may cause lacrimal sac distension.

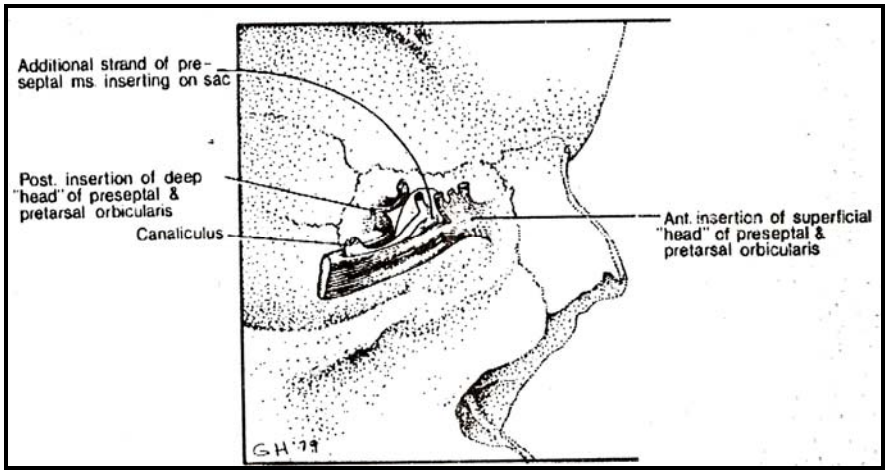


Dimensions of the Lacrimal Drainage System[36]

External massage may cause the contents to reflux through an incompetent valve of rosenmuller and through the canalicular system into the surface of the eye.[28] The lacrimal sac lies within a fossa in the anterior portion of the medial orbital wall .This fossa is formed by the frontal process of the maxillary bone and the lacrimal bone.[33]

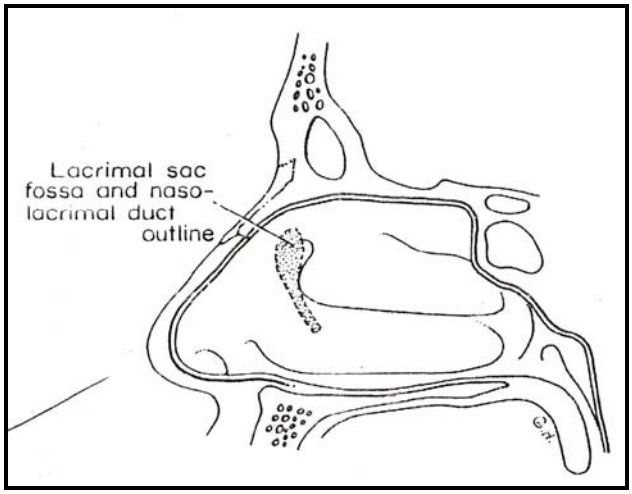
The sac lies between the anterior & posterior crura of the medial canthal tendon, which is a complex structure composed of superficial & deep heads of the pretarsal oculi muscle. The superficial head attaches to the anterior lacrimal crest, the deep head (Horner's muscle) attaches to the posterior lacrimal crest within the lacrimal sac fossa. The angular artery and vein lie 7-8

mm medial to the medial canthal angle.[28] The dome of the sac, which extends above the medial canthal tendon, is covered by tough fibres that cause the fistula to exit and most sac distensions to extend below the medial canthal tendon. [16]

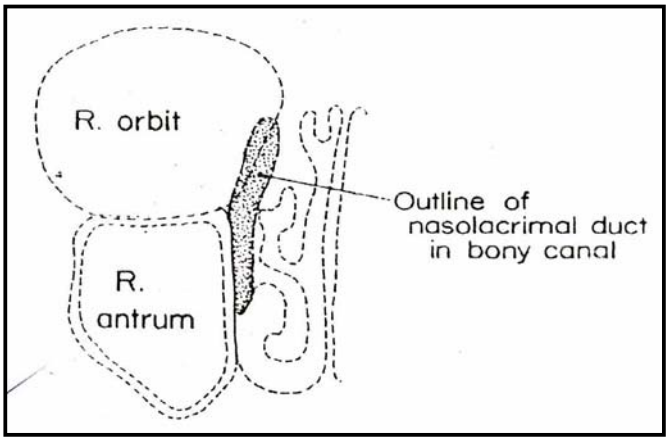


Drawing 2: the anatomical bony and tendinous landmarks of the lacrimal sac.[16]

Medial to the sac is middle meatus of the nose & sometimes anterior ethmoid cells, separated by the thin lacrimal bone and the thicker frontal process of the maxilla.



Drawing (3): sagittal view of the lacrimal sac location, as seen from nasal mucosal side.16



Drawing (4): outline of N L D in bony canal.[16]

The lacrimal sac empties into the nasolacrimal duct just as it enters the nasolacrimal canal in the maxillary bone.[9] The nasolacrimal duct measures approximately 12 mm in length. Its upper portion curves generally in an inferior and slightly lateral and posterior direction. The distal portion bends medially in an irregular J-shape in many neonates, but it bends to straighten out with growth. The distal portion extends into the middle meatus before penetrating the nasal mucosa, forming the meatal portion of the duct, and then open into the nose through an ostium under the inferior turbinate that is usually partially covered by a mucosal fold called the valve of Hasner.[28] This mucosal fold prevents retrograde movement of fluid up to the duct from the nasal cavity.[37,38] The configuration of the ostium varies, but it located fairly anteriorly in the inferior nasal meatus, approximately 2.5 cm posterior to the naris.[28]

1 -3 – 2 – EMBRYOLOGY

Lacrimal gland is formed from about 8 cuneiform epithelial buds which grow by the end of 2nd month of life from the super lateral side of the conjunctival sac.

In the 7 mm embryo a depression termed the nasolacrimal groove develops between the lateral nasal and maxillary processes, then the depression thickens and becomes buried to form a rod. canalization of this nasolacrimal ectodermal rod begins at the 32 to 36 mm stage of development. The central cells of the rod degenerate, forming a lumen closed at the cephalad end by conjunctival and canalicular epithelium and closed at cauded end by nasal and nasolacrimal epithelial components .The superior membrane is normally open by birth, whereas the inferior membrane often persists in newborns.[39]

The lower end of the lacrimal duct is the last to canalize, and in more than half of infants the last portion of this nasolacrimal stem may not completely finalize its patency at birth.[40,41] Congenital absence of any segment of the nasolacrimal system, supernumerary puncta, and lacrimal fistulas demonstrates abnormalities of development in this region.[42,43]

1- 3- 3 - HISTOLOGY

The canaliculi are lined with stratified squamous epithelium while the sac and the nasolacrimal duct are lined by non ciliated columnar epithelium.[44]

The walls contain large amounts of elastic tissue particularly the walls of the canaliculi. In addition, the lacrimal sac and the nasolacrimal duct have collagen, elastic fibers, and amounts of lymphoid tissue in the walls. The mucous membrane within the sac and nasolacrimal duct is arranged into membranous folds that act as valves .The two most important folds, as best as can be determined clinically, are the valve of Rosenmuller, where the common canaliculus enters into the sac, and the valve of Hasner (plica lacrimalis) at the end of the nasolacrimal duct under the inferior turbinate. Other valve like folds have been identified, as have valve like constrictions at the junction of the sac in the nasolacrimal duct (valve of Krause, sinus of Arlt) and within the nasolacrimal duct (spiral valve of Hyrtl and the valve of Tail).[16]

Aging changes in orbital adnexa and lacrimal system

The eye brow position heightens in both genders with increasing age.[45] The aging process is apparent in the eyelids as tissue atrophies , the skin loses elasticity , and wrinkles appear. With age the distance between the center of the pupil and the lower eyelid margin increases due to sagging of the lower lid,

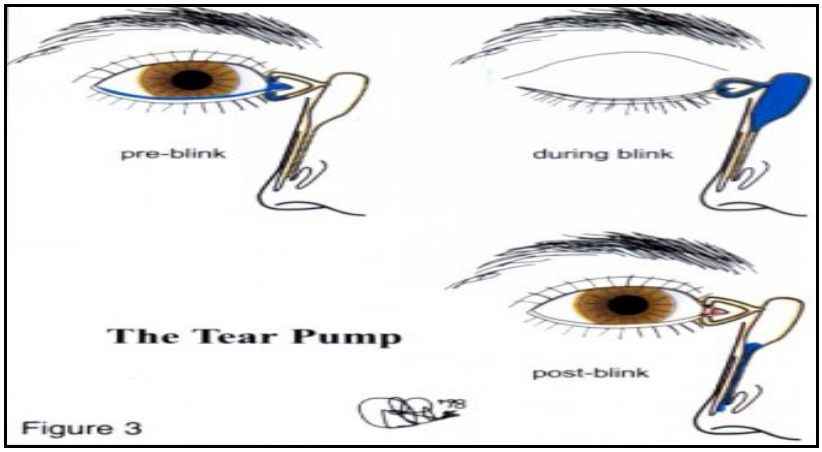
this change is greater in males than females.[45] More pronounced changes in lid margin position, including ectropion and entropion increase in incidence with changes in the orbicularis muscle tone .Tearing may be caused by eversion of the lower punctum due to eyelid position or by stenosis of the passages in the lacrimal drainage system, both occur more frequently in elderly persons .The basal rate of tear secretion diminishes after age 40 contributing to dryness, the incidence of which increases with age due to loss of glandular tissues .[46,47,48]

1 – 3 – 4 - PHYSIOLOGY

The secreted tear volume is eliminated by evaporation which accounts from 10% to 25% under normal conditions.[24] Some of the tear volume may be absorbed in the nasolacrimal system but most of the tear flow is actively pumped from the tear lake by the action of the orbicularis muscle.[49,50,51]

The jones description of the lacrimal pump was accepted for years; later physiologic studies suggested a better explanation. In the tear pump described by Rosengren-Doane, the contraction of the orbicularis provides the motive power. The contraction is thought to produce positive pressure in the tear sac, forcing tear into the nose. As the eyelids open & move laterally, negative pressure is produced in the sac & contained by the valve of Hasner. When the eyelids are fully opened, the

puncta finally pop open and the negative pressure draws tear into the ampullae and canaliculi .[30,52]



The lacrimal Pump[36]

Traditional teachinqs have previously held that the lower canalicular drainage system was far more important than the upper system. However, recent studies by White and colleagues and Daubert and associates[40,53] have demonstrated equal tear flow between the upper and the lower canalicular systems using radioactive dacryoscintograhy flow studies. Linberg and moore [41] evaluated the clinical symptoms associated with alternate monocanalicular occlusion of the upper and lower puncta . They found that approximately 50% of patients experience mild intermittent symptoms of epiphora associated with experimental monocanalicular obstruction. The symptoms were identical whether patient's upper canalicular system or lower canalicular system was occluded. A number of important clinical principles can be derived from the physiologic information just provided. Present evidence supports the crucial role of the palpeberal-canalicular pump mechanism in lacrimal elimination. All efforts

should be made to preserve the lacrimal canaliculi. Repeated instrumentation of the lacrimal system or nasolacrimal duct probings are unlikely to help the underlying pathology and may in themselves injure the canaliculi and thus permanently impair lacrimal elimination. Very little can be done to restore scarred fibrosed canaliculi. Surgeons should also give equal consideration to a patient with lacerations of either the upper or lower canaliculus. Traditional teachings that upper eyelid canalicular lacerations are unimportant are simply not true.[30]

1 – 3 – 5 - PATHOLOGICAL DISORDERS OF THE LACRIMAL SYSTEM

Pathological disorders of the lacrimal system might be divided into congenital and acquired.

A - Congenital disorders of the lacrimal system:

1. Anomalies of the puncta:

Agenesis of one or two lacrimal puncta is a rare cause of presentation to ophthalmologists. Where normal canalicular tissue lies within the lid, it may occasionally be successfully exteriorized to the conjunctival surface with relif of symptoms. Punctal agenesis is usually associated with the absence of underlying canalicular tissue.[54]

Congenital atresia of the puncta has been rarely reported in the literature. It can occur in isolation or in association with other congenital anomalies.[55]

Supernumerary or double puncta, and congenital slits of the puncta all may occur. Lateral displacement of the puncta may occur in some congenital syndromes, such as blepharophimosis.[56]

2. Anomalies of the canaliculi:

Atresia or failure of canalization of the lacrimal canaliculi may occur in conjunction with punctal atresia.

In many cases, particularly in patients with mesodermal dysplasia, the lacrimal canaliculi and puncta may be absent, a normal tear sac and nasolacrimal duct may be present but not connected to the eye lid surface.[56]

3. Anomalies of the sac:

Although diverticuli of the lacrimal sac may occur, a congenital fisula of the lacrimal sac, which has been termed lacrimal anlagen duct by Jones, is more common.[56] In some cases it is found to be autosomal dominant and may coexist with thalassemia. It is undoubtedly the result of canalization of a strand of epithelial cords that extends from the sac to the skin surface forming fistula .The fistulas often have to be completely excised to prevent drainage of tears externally on the skin.[57]

4. Anomalies of the nasolacrimal duct:

a) Dacryostenosis:

Nasolacrimal duct obstruction (NLDO) is a relatively common clinical problem. Symptoms of NLDO probably occur in 5 to 6% of infants.[58] The nasolacrimal duct doesn't canulate until birth, and there may be a persistant membranous obstruction at the bottom end of the nasolacrimal duct in up to 70% of neonates.[59] Spontaneous reolution occurs in 90 % of these obstructions within the first year of life.[60] Some of babies will still have symptoms at the age of one month, with less than 1% still having symptoms at one year of age.[61,62] Most obstructions occur where the nasolacrimal duct enters the nasal cavity. Blind pouches can occur rarely within the turbinate itselfThere are normal variations in the position of the opening of the nasolacrimal duct under the inferior turbinate. The nasal ostium of the duct, at the highest portion of the inferior meatus within the vault beneath the inferior turbinate, is usually wide open. It may be puckered, or grooved down the lateral wall of the nose or have a puncture – like appearance in the vault of the turbinate.[63].

b) Absence of valves:

The fold normally presents at the end of the nasolacrimal duct or valve of Hasner may be absent, in which case, pneumatoceles of the sac may occur and nose blowing may cause retrograde passage of air.

If the valve of Rosenmuller is also absent, it is possible to blow air from the nose into the eye, and nose bleeds may produce bloody tears.[56]

Congenital nasolacrimal anomalies, particularly, obstruction, can lead to various clinical manifestations including the following:

1 - Dacryocystocele (Amniotocele):

It is a cystic dilatation of the lacrimal sac at the nasocanthal angle due to complete obstruction of the lacrimal duct, inferiorly by non-permeability of the valve of Hasner, and superiorly by a valve mechanism at the valve of Rosenmuller.[64]

The number of cases reported in the literature is small: fewer than 40 cses.[65,66,67,68] The origin and composition of the sac contents is amniotic fluid since the tear secretion normally is not significant until 3 to 4 weeks postpartum.[69] The infant encounters no clinical signs of epiphora (tearing) or dacryocystitis (infection). The only clinical finding is that of a bluish mass below the medial canthal tendon. The dacryocystocele is typically sterile since colonization of the lacrimal drainage system is usually not established until the first several weeks of life. When infected, the most common bacteria isolated are staphylococcus organisms.[70] Spontaneous resolution may occur during the first few weeks of life before bacterial colonization and significant tear production commence.[64] Hot compresses and massage is the initial treatment and most infants

will require probing. Dacyocystocele should be differentiated from frontonasal meningcele, hemangioma and dermoid cyst, although these are either unlikely in the age group, or have a different echotexture. [64]

2 - Dacryocystitis (acute muococele or pyocele):

This condition exhibits acute distention and inflammation in the lacrimal sac region and may occur in the neonatal period. Probing is necessary in newborns with acute dacryocystitis to establish drainage as soon as possible .This procedure is performed with topical local anaesthesia only.[64]

3- Tearing and mattering:

Newborns that have congenital dacryostenosis may not develop acute dacryocystitis with mucocele or pyocele of the sac in the early neonatal period but may simply have tearing with a chronic mucopurulent discharge, which usually manifests at 2 weeks. Topical antibiotics should be administered, and the parents must be instructed in the proper technique of lacrimal sac compression and massage. More than 90% of these cases clear and become a symptomatic with conservative management. Under normal circumstances, these children with mild-to moderate symptoms of epiphora and lid crusting can be monitored for the first year of life without serious consequence or sequela. It is rarely necessary to make probing mandatory at an early age (e.g, before 6 months of age). A number of studies

have now confirmed that probing or silicone tube intubation in children after 12 months still has a very high success rate.[56]

B - Acquired disorders of the lacrimal system:

1. Disorders of the puncta:

a) Punctal stenosis**:**

Acquired external punctal stenosis (AEPS) is an involutional punctal stenosis mainly found in post-menopausal women which may be related to chronic blepharitis, or it may be seen iatrogenically as in the treatment of dry eye by the use of punctal plugs and thermal cauterization which may lead to permanent punctal occlusion.[71] Mechanical obstruction of the puncta can be induced by conjunctivochalasis which is due to excessive distention of the conjunctiva, particularly inferonasally, that leads to prolapse over the punctal opening. This condition can be divided into several groups based on severity. Moderately severe conjunctivochalasis can lead to epiphora due to interference with inferior tear meniscus and occlusion of the inferior punctum.[71] Mild conjunctivochalasis may contribute to an unstable tear film and dry eye syndrome.[72] Occasionally, alarge hordeolum or chalazion may induse punctal stenosis.[73] The management of AEPS includes a two-or three snip punctoplasty, punctal punch revision, micropunctoplasty or silicone tube insertion.[74] Mechanical obstruction of the puncta

can be caused by neoplasms or as a side effect of some drugs such as:

- Topical idoxuridine (IDU) which is an antiviral medication for Herpes *simplex* and antiglucoma eye drops[71].
- Docetaxel is one of toxoid chemotherapeutic agents work against cancer by interfering with the process of mitosis.[75] Epiphora as a side from docetaxel therapy was first described in 2001.[76] It is hypothesized that the drug is secreted in the tear film and that direct effect from the chemotherapeutic agent on the mucosa results in fibrosis of the punctum.[77]

Since some fibrosis has been reported elsewhere in the body of patients on docetaxel,[78] the mucosal fibrosis in the lacrimal system may be secondry to the systemic effects of the drug.[75]

b) Punctal displacement:

One punctum is present at the medial end of both the superior and inferior lid. They are situated on slight elevations called the lacrimal papillae and face posteriorly so it is necessary to evert the medial lids to inspect them. Displacement is more commonly an acquired anomally in older individuals with eye lid laxity and senile ectropion. Other examples include entropion and floppy eyelid syndrome.[73] Punctal ectropion may occur after lower lid blepharoplasty,[71] it may also occur after injury or burns with skin contracture.

c) Neoplasms:

Primary neoplasms may arise in the puncta but secondary spread from nearby tissue is more common than primary tumors. Basal cell carcinoma occur in the inner canthal area, and benign growths in this area often involve the punctum. Metastatic spread, an extremely rare phenomenon, has been reported with primary sites from the breast and prostate.[79]

2. Disorders of the canaliculi:

a) Atresia:

Acquired atresia of the canalicular system may be secondary to the following:

1- Radio / chemotherapy:

Obstruction of distal upper and lower canaliculi rarely caused by the use of Iodine (131) for thyroid carcinoma. It has yet to be established if the obstructions results from local toxicity caused by the passive flow of radioactive iodine containing tears through these tissues or the active uptake and concentration of iodine [I(131)] in lacrimal drainage system tissues through the sodium /iodide supporter.[80]

It can be occurred in patients who received 5-FU or Docetaxel as a chemotherapeutic agents. Occlusion of the canaliculi occurs after irradiation for basal cell carcinoma, although intubation with silicone tube may prevent this problem in some cases.[81]

2- Lacerations:

Lacerations of the canalicular system result from direct or indirect trauma. Direct trauma includes severing of the lacrimal portion of the lid with objects, such as glass, coat hangers, knives, dog bites, cat claws, finger nails, or other sharp objects. Indirect trauma results from blunt injury to the ocular adnexa from such mechanisms as blows to the face, blunt weapons, or

falls onto blunt objects. All lacerations may cause obstruction of the canaliculi. [82]

3- Repeated probing:

One of the most common causes of stenosis of the lacrimal canaliculi . [82]

4- Cicatrizing conjunctivitis:

Atresia of the canaliculi may follow infections such as Herpes *simplex*, Herpes *zoster*, Vaccinia,Trachoma, and Infectious *mononucleosis*.[83] Other inflammations such as Stevens-Johnson Syndrome or ocular pemphigoid may lead to canalicular atresia. Intermittent allergic obstruction at the level of the canaliculus or lacrimal sac has been demonstrated. This phenomenon is associated with allergic onjunctivitis and noted in patients who chronically rub their eyes.[84]

5- Drugs:

Eye drops such as echothiophate (phospholine) iodide which is used in the management of glaucoma has been incriminated as a cause of canalicular stenosis. Idoxuridine which is an antiviral agent may cause temporary occlusion of the punctum and canaliculi.[16]

b) Canaliculitis:

Inflammation of the canalicular system can occur secondary to dacryocystitis, but isolated bacterial infections of the canaliculus are rare perhaps the most common infections are caused by the fungi (Streptomyces, Actinomyces *israeli,* and Arachina *Propionica* (previously labeled as Streptothrix).

Fungal infections with organisms such as Candida *albican,* Aspergillus *niger*, and Nocardia have been reported. However, Actinomycotic infection is by far the most common.[16] The patient reports epiphora, but swelling and inflammation of the lid medially are noted. The punctum is swollen and red, also mucoid and mucopurulent discharge is present .In contrast to dacyocystitis, there is absence of nasolacrimal duct obstruction, lacrimal sac distention and inflammation.[85] Irrigation may or may not be possible through the canaliculus, and a small probe may encounter gritty resistance. Diagnosis is made on, expressing yellow-tinged concertions from the canaliculus. On cytologic examination, they show gram-positive branching filaments. [85]

c) Tumours:

The most common tumours that affect the canaliculi and the punctum but none grossly occupied them are carcinoma, lymphoma and papilloma. The rest were either oncocytoma or melanoma.[86] Infilterating papillary squamous cell carcinoma is

the most rapid and destructive recurrence of any tumor originating in the lacrimal system.[87] The researchers found that the three most common presentations of these tumours were epiphora, palpable mass and dacryocystitis.[85]

3. Disorders of the lacrimal sac:

a) *Dcryocystitis:*

It is infection of the lacrimal sac usually occurs in infants or in women over 40 years of age. In adults, dacryocystitis results from obstruction of the nasolacrimal duct. It can be either acute or chronic infection and both forms are usually unilateral in nature. The hallmark symptom of both forms of dacryocystitis is epiphora. In acute infection; the area around the lacrimal sac is painful, red, and swollen. [88]

The eye become red, watery and may ooze pus. Slight pressure applied to the lacrimal sac may push pus through the lacrimal punctum, often the infection is mild. Sometimes, it is severe and can cause fever, an abscess may form, which can rupture through the skin, creating a passage for drainage. Chronic infection is presented with epiphora which may be associated with a chronic or recurrent conjunctivitis.[69] The most common organisms that cause infections are Pneumococci. Other organisms include Streptococci, Diphtheroids, Klebsiella *pneumonia,* Haemophilus *influenza,* Pseudomonas *aeruginosa,* and mixed organisms. Actinomyces and fungi, such as Candida,

are not infrequent, granules and casts of the nasolacrimal duct and sac may be present in these cases.[16]

In UK, a microbiological study showed 78.5% of the growths were gram-positive bacteria, while 76.5% of them were Staphylococcus *species*.[89] Another study in Japan reported that a series of 4 cases of dacryocystitis with culture growth positive for MRSA (methicillin resistant Staphylococcus *aurius*), which is regarded as one of the most difficult organisms to be treated, which showed dramatic response after Ext – DCR with complete resolve of all symptoms.[90]

A chronic recurrent dacryocystitis has been reported in conjunction with systemic sarcoidosis.[91]

The differential diagnosis of dacryocystitis includes a number of different clinical entities. Lacrimal sac neoplasms, unless infected, are generally not tender and of a slower onset. In neoplastic disease, the mass in many cases extends above the level of the medial canthal tendon, which does not occur in dacryocystitis because of the compression of the fundus of the sac by the medial canthal tendon.[90]

A congenital midline meningoencephalocele may present as a mass in the lacrimal sac area and cause a secondary dacryocystitis.

This anomaly may or may not communicate with the intracranial cavity. Dermoid cysts can occur nasally, although they are more often located in the supra-nasal quadrant and most

usually are located at the lateral brow. Ethmoidal and frontoethmidal mucoceles can occur and produce a firm mass-like swelling at the inner canthal area and also a secondary dacryocystitis. Skin cysts and inclusion cysts may simulate a mass in the lacrimal sac area.[16,35]

An acute infection is usually treated with antibiotics orally. If the infection is severe, antibiotics given intravenously may be required. Applying warm compresses to the area several times a day also helps.

If an abscess develops, minor surgery may be performed to open and drain it. The treatment for chronic infection especially if recurrent is by dacryocystorhinostomy.[69]

b)Tumours of the lacrimal sac **:**

Neoplasms of the lacrimal sac are uncommon, especially in children. They include epithelial (75%) and non-epithelial (25%) tumors, such as mesenchymal tumors (12%), melanoma (5%), and malignant lymphomas (< 6%).[97] Lymphoma of the lacrimal sac, however, is unusual. Twenty-one cases of primary lymphoma of the lacrimal sac have been reported during the past 30 years[92-101]. The median age at onset was 51 years, and only one case was younger than 18 years.[92] A case report of primary non-Hodgkin lymphoma of the lacrimal sac was in a 10- year-old.[102] A poorly differentiated carcinoma with an islet-alveolar distribution has been reported.[103] Other primary lacrimal sac tumors that have been reported are

oncocytic adenocarcinoma, neurilemmoma, adenocanthoma, hemangiopericytoma,and fibrous histiocytoma.[104]Neurofibroma of the lacrimal sac is an extremely rare neural tumour. Until now, only four cases have been reported world wide.[105] The lacrimal sac may also be involved secondary in patients with leukemia, particularly older patients with chronic lymphocytic leukemia.[97,106] The most common initial signs and symptoms were epiphora, chronic inflammation, or lacrimal mass. A bloody nasal discharge and bleeding from the punctum occurred in patient with malignant melanoma.[98] Bleeding on probing of the lacrimal system is not an infrequent finding in sac tumors. .[98]

The management of the lacrimal sac lymphoma remains controversial.[102] Biopsy of the lacrimal sac plays a diagnostically important role in acryocystorhinostomy even in the absence of obvious tumours involvement of the lacrimal mucosa.[107] The lacrimal sac biopsy in patient undergoing DCR should be performed only in those with a positive history for systemic disease or an abnormal appearing lacrimal sac during surgery.[105] The most common treatment is external beam radiation, either alone or in combination with systemic chemotherapy or excisional biopsy and systemic chemotherapy, with no external beam radiation. Systemic chemotherapy rather than radiotherapy may avoid potential persistent epiphora due to radiation induced lacrimal duct stenosis.[102] Intubation of the lacrimal passages with silicone tube before irradiation is

indicated, and normal lacrimal drainage function for the patient after treatment may be retained. [102]

C) ***Dacryoliths*** (shed epithelial cells, amorphous debris, and lipids with or without calcium) or cast formation within the lacrimal sac:

Dacryoliths can produce obstruction, or they may result from preexisting obstruction. Infection with Actinomyces *israeli* or Candida *species* can cause dacryoliths.[108,109] A case report from Denmark showed that Aspirogillous *fumigatus* can also form a plug.[110] Casts may also occur with long term administration of topical medications such as epinephrine.[108,109, and 111]

The underlying causes for the formation of stones are unclear. However, the predictive factors for dacryolith are: male gender and sac distention, they occur more frequently under the age of 50 and in heavy smokers.

The clinical signs and symptoms are intermittent epiphora, lacrimal obstruction, recurrent conjunctivitis, intermittent dacryocystitis, and variable localized tenderness. Acute impaction of a dacryolith in the nasolacrimal duct can produce acute non infectious dacryocystic retention, severe painful lacrimal colic with a minimally enlarged non-inflamed sac.[108,109]

Dacryocystography is helpful in the diagnosis of this condition. Mechanical removal of the impacted dacryolith,

usually along with a DCR, is necessary to relieve symptoms.[108,109]

4. Acquired disorders of the nasolacrimal duct:

- Obstruction of the nasolacrimal duct: It might be congenital or aquired. The congenital one has been discussed in the congenital anomalies of the lacrimal system.
- Acquired nasolacrimal duct obstruction, can occur at any age and is divided into primary and secondary.
- The primary acquired nasolacrimal duct obstruction (PANDO) is caused by inflammation, or fibrosis without any precipitating cause.[104] It is more common in middle-aged and elderly females. They demonstrated using CT scans, that women have significantly smaller dimensions in the lower naslacrimal fossa and middle nasolacrimal duct. They noted that changes in the anteroposterior dimensions of the bony nasolacrimal canal coincide with osteoprotic changes throughout the body.[112] These may explain the prevalence of the disease in the middle-aged and elderly females. Hormonal changes that bring about a generalized de-epithelization in the body may be the same within the lacrimal duct. An already narrow lacrimal fossa in women predispose them to obstruction by the sloughed off debris.[113]

- The secondary acquired lacrimal duct obstruction (SALDO) is caused by inflammation or fibrosis with precipitating cause such as infectious, inflammatory, neoplastic, traumatic, or mechanical factors.[94] Infections with bacteria, viruses, fungi and parasites have been implicated as causes of SALDO. Bacteria such Actinomyces, propioniobacterium, Fusobacterium, Bacteroides, Mycobacterium, and Chlamydia *species* have been associated with lacrimal drainage obstruction. Other bacteria include Nocardia, Enterobacter, Treponema pallidus, and Staphylococcus *aureus.* Viral causes are seen with herpetic infection (e.g Herpes *simplex*, Herpes *zoster*, Chichenpox, epidemic keratoconjunctivitis).[113] Fungi may obstruct lacrimal passages by forming stone (dacryolith) or cast. Species associated with obstruction are Aspergillus, Candida, Pityrosporum and Trichophyton. Parasitic obstruction is rare but is reported in patients infected with Ascaris *lumbricoids,* which enters the lacrimal system through the valve of Hassner.[113] Inflammation may be endogenous or exogenous in origin. Wagener granulomatosis and sarcoidosis are 2 examples of conditions that lead to obstruction due to progressive inflammation within the mucosa of the nasolacrimal passages. Other endogenously arising inflammation associated with

lacrimal obstruction are cicatricial pemphigoid, sinus histiocytosis, Kawasaki disease and scleroderma.[113] Exogenous causes of cicatricial lacrimal drainage obstruction are systemic chemotherapy, bone marrow transplantation and radiation. [113]

A causal relation ship between Iodine (131) administration for thyroid carcinoma and nasolacrimal drainage system obstruction (NDSO) is strongly suspected.[114,115] It was reported that chronic intra-nasal cocaine abuse can cause obstruction of the nasolacrimal duct.[116] Neoplasms may cause lacrimal obstruction by primary growth, secondary spread growth, or metastatic spread.[113] Primary neoplasms may arise in the puncta, canaliculi, lacrimal sac or nasolacrimal duct. Nasolacrimal duct obstruction caused by oncocytoma and adenocarcinoma , ex-pleomorphic adenoma of the lacrimal sac and nasolacrimal duct have been reported.[117,118] The possibility of these tumours is rare but it should be kept in mind. The majority of these tumours are malignant.[116] Secondary spread from nearby tissues is more common than primary tumours, they are most commonly eyelid cancers (basal cell and squamous cell carcinoma), and also spread from the maxillary antrum and the nasopharynx have been reported.[113] Bajaj et al reported a dentigerous cyst with a tooth in the roof of the maxillary sinus lead to nasolacrimal duct obstruction.[16,119] Metastatic spread, is an extremely rare

phenomenon, has been reported with primary sites in the breast and prostate.[113]

Trauma can lead to scarring and obstruction of the lacrimal passage which might be iatrogenic following aggressive lacrimal probing, orbital decompression surgery, paranasal, nasal and craniofacial procedures.

A number of cases of dacryostenosis have been reported after cosmetic rhinoplasty.[118] Non- iatrogenic traumatic causes are either blunt or sharp trauma which most commonly involves the canaliculus, lacrimal sac, and nasolacrimal duct.[113]

Mechanical lacrimal drainage obstructions may be due to intra-luminal foreign bodies, such as dacryoliths or casts. These may be caused by infection (e.g Actinomyces, Candida) as well as long-term administration of topical medications. Mechanical obstruction may also be caused by external compression from rhinoliths, nasal foreign bodies, or mucoceles.[113] The distal aspect of the nasolacrimal duct may be obstructed as a result of intra-nasal pathology. Intra-nasal scarring with inferior turbinate adhesions may occur as a sequela of trauma, radiation therapy or surgical procedures. Allergic rhinitis may be associated with nasal mucosal hypertrophy. In some individuals, an abnormally wide nasal vestibule is associated with compensatory hypertrophy of the inferior turbinate that occludes the valve of Hasner.[119-121] Nasal tumours are uncommon and can be benign, such as granulomas or nasal polyps, or malignant such as

squamous cell carcinoma can cause obstruction for the distal aspect of the nasolacrimal duct. [120]

The presenting signs and symptoms of nasolacrimal duct obstruction include epiphora, conjunctivitis, and mucoid discharge. Dacryocystitis may develop when bacterial growth occurs in the stagnant fluid of the lacrimal sac. Whereas acute dacryocystitis is usually characterized by tender preseptal cellulites, chronic dacryocystitis typically manifests as painless purulent reflux from the lacrimal sac. A rare risk of untreated, chronic dacryocystitis secondary to an acquired nasolacrimal duct obstruction is orbital cellulites.[1, 116]

A common but under -recognized causes of tearing

Lacrimal pump failure:

It is a functional failure related to poor lacrimal pump function which may be due to displaced punctum, eyelid laxity, and weak orbicularis or cranial nerve 7th palsy.[73] Any condition that impairs the normal contractile and elastic properties of the palpebral –canalicular pump mechanism can cause epiphora. These conditions include scleroderma, radiation, fibrosis of the eyelids, and cutaneous burns or trauma of the periocular region. Chronic or recurrent canaliculitis may leave the canaliculi anatomically patent but functionally impaired. Facial nerve paresis is among the most common situations in which lacrimal pump failure is present despite patency of the membranous lacrimal conduit.[73]

Conjunctivochalasis:

This condition is due to excessive distention of the conjunctiva, particularly inferonasally that leads it to prolapse over the punctal opening leading to tearing. It is relatively recently described as a cause of epihpora in many patients. Severe conjunctivochalasis may be due to an exposure problem which is often due to drying of the conjunctiva and continued chronic irritation leading to further chalasis and swelling. Conjunctivochalasis can lead to pain, marginal corneal ulcer (dellen), or subconjunctival hemorrhage due to mechanical

rubbing. Moderatelly severe one can lead to interference with tear clearance. The conjunctivochalasis may contribute to an unstable tear film and dry eye syndrome.[72]

The management of conjunctivochalasis based on the severity of the condition. If mild, simple observation is needed. Treatment is indicated if tearing, irritation, and obstruction occur. Treatment may entail artificial tear drops, corticosteroid or antihistamine eye drops or patching before sleep. These strategies can help to settle inflammation and swelling of the conjunctiva. More severe cases need surgical intervention with procedures designed to excise the excess conjunctiva and to create a firm adhesion to the underlying tissues to stop recurrence.[71]

1 – 3 – 6 - MANAGMENT

Diagnosis

Disorders of the lacrimal system can be diagnosed from the history, signs symptoms, clinical examination, lab studies, imaging studies and other tests.[79] The patient should be evaluated in a systemic manner and not all steps are needed because the diagnosis may be apparent with some simple tests.

Evaluation of pediatric patient with epiphora :

Though congenital nasolacrimal duct obstruction is the most common cause of epiphora in pediatric age group, other conditions that could lead to watering in child need to be excluded to avoid mismanagement. If watering is intermittent or has started more than a month after birth, it is unlikely to be due to congenital nasolacrimal duct obstruction. Presence of long-standing epiphora associated with a quite eye and mucoid or mucopurulent discharge is invariably diagnostic of congenital NLD obstruction.[108]

1. Pseudoepiphora :

It can be found in the following cases**:**

a) Epiblepharon: Which is a fold of skin that pushes the normally directed lashes against the globe. This may not be clear in primary position, but becomes apparent in the

downward gaze. As the nasal structure develops the fold of skin disappears.

b) Distichiasis:

It is the presence of abnormal lashes at the openings of meibomian gland. The lashes may appear normal. Examination under magnification might be necessary to pick up the diagnosis.

c) Trichiasis:

Which is misdirection of the normal eye lashes onto the cornea and is relatively uncommon in the paediatric age group.

d) Congenital glaucoma:

Children with watering, photophobia, enlarged hazy cornea are most likely to have congenital glaucoma. Once the causes of pseudoepiphora are excluded, the lacrimal drainage system warrants close attention.[122]

2. Evaluation of true epiphora:

Examination of the lacrimal lake is most essential. If it is filled with tear, it is indicative of outflow obstruction. Regurgitation of mucoid or mucopurrulent material from the puncta on pressure over the sac area is indicative of nasolacrimal duct obstruction. At times a dilated sac may be palpable. Absence of the puncta can be identified clinically, if

the child cooperates, with the help of loupes and bright illumination.

Evaluation of an adult patient with epiphora:

1) History:

The history of the patient's problem may help to explain the cause of epiphora. Often, watery eyes are related to poor tear film, which causes ocular irritation (or reflex tearing). Tearing that is worse in wind or in cold air may be caused mostly by dry eye, and partial lacrimal obstruction. Tears that flow down onto the cheek, especially at rest in indoor environments, are usually caused by lacrimal obstruction. It is important to note that upper lacrimal system obstruction causes clear tearing only, while obstruction of the lower system (usually of the nasolacrimal duct) causes tearing often with mucopurulent discharge. Unilateral symptoms are often due to the local agents, such as anti-glaucoma drops used in only one eye. A history of allergic conjunctivitis, rhinitis, or sinusitis can also lead to acute or chronic blockage of the puncta or opening of the naslacrimal duct and may cause secondary epiphora.[71] A history of bloody tears, epistaxis which may be due to nasal or lacrimal sac tumor is also related to epiphora.[78] Past ocular history of previous eye surgery, lid surgery use of antiglaucoma or other topical medications may help to find the cause of epihpora.[79]

The past medical history of lymphoma, Wegner granulomatosis, sarcoidosis, ocular cicatricial pemphigoid, scleroderma, sinus histiocytosis, previous radiation treatment to medial canthal area or systemic chemotherapy, parasitic infection, facial trauma and previous nasal or sinus surgery, all of these are also related to epiphora.[79]

2) Inspection:

Inspection of the eyelid for anatomical abnormalities (e.g ectropion, entropion, lower lid laxity, and lacrimal pump weakness due to Bell's palsy) that may lead to structural and functional problems in the distribution and drainage of the tears is also important.[71].

3) Palpation:

Palpation of the outflow system demonstrates the level of obstruction or any localized problems. One may see or feel a mass, and the patient may complain of tenderness. Any mucopurulent or bloody discharge elicited by compression of the sac (regurgitation test) may signify problems distally or a lesion in the sac itself.[71]

4) Slit lamp examination:

It helps to check punctal stenosis or malposition, it can also show any conjunctival problems, such as conjunctivochalasis. An evaluation of dry eye, as this may lead to pseudoepiphora (reflex tearing). On slit-lamp examination one may see an

abnormal tear meniscus, punctate erosion, prolonged tear break-up time, or an abnormally poor Schirmer test. [85]

Local mechanical causes of epiphora, such as trichiasis, distichiasis, conjunctivitis, keratitis, and uveitis are also obvious on slit-lamp examination.[71]

5) Lab studies:

Send lacrimal discharge for the following studies (depending on suspected etiologies):

- Gram stain/Giemsa stain.
- Culture and sensitivities.
- Anticytoplasmic antibodies (Wegner granulomatosis). Monitor disease activity. [71]

6) Diagnostic tests:

Tests for evaluation of the lacrimal drainage system can be divided into functional and anatomical evaluations. [122]

a) Functional (physiological tests) evaluation:

The functional tests are for the diagnosis of tear flow under natural physiological condition as well as the level of any obstruction. [122]

- Dye Disappearance Test (DDT):

It is one of the most convenient, useful simple and physiologic indicators for the outflow system of the patients.[122] In this test, a drop of 2% fluorescein dye solution is placed in

both eyes in the inferior fornix and the tear meniscus height is measured. Normally very little or no dye remain after 2 minutes.

A prolonged retention of dye is indicative of inadequate lacrimal drainage and can be graded from 1 to 4. This test is most valuable when the epiphora is asymmetric and very useful test for both children and adults. The DDT is different from the fluorescein clearance test (FCT) for dry eye. The FCT also allows one to check basal and reflex tearing, which assists the diagnosis of epiphora. The FCT allows one to visually check the color of the tear meniscus 15 minutes after the instillation of 5 micro-liters of fluorescein drop if there is slow drainage; the tear meniscus is still brightly colored with the dye. These tests have been validated in many previous reports as being useful in the assessment of the causes of epiphora.[123-126]

- The Micro -Reflux Test (MRT):

It is a new reliable screening test for presence of complete lacrimal duct obstruction.[127] In this test two drops of 0.25% sodium fluorescein dye are placed in the inferior cul-de sac and the patient made to blink five times to activate the lacrimal pump mechanism. Excess fluorescein dye was blotted away using tissue paper. The patient is positioned at the slit lamp, and observation of the inferior punctum with the cobalt blue filter is done using 5x magnification. The tissue overlying the lacrimal sac is massaged in a counter clock wise direction with moderate

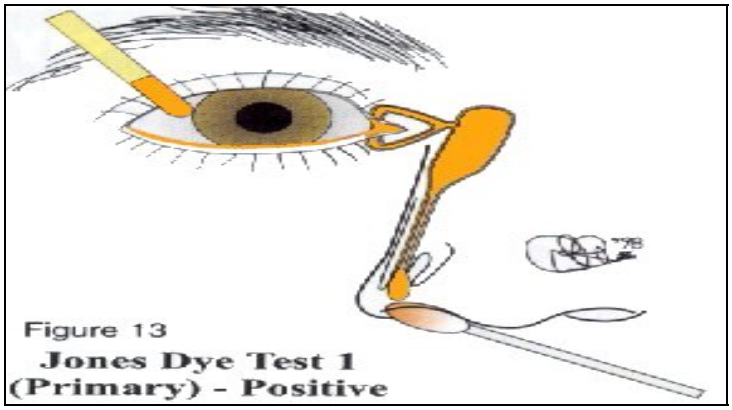
pressure using the index finger. The test is considered positive if there is continued observed reflux of fluorescein-stained tears from the inferior punctum after the initial counter clock wise massage to empty the inferior canaliculus. The MRT used for the evaluation of complete PANDO has a sensitivity of 97% and specificity of 95%.[127]

- Jones dye testing:

It is only indicated in patients suspected with partial obstruction of the drainage system.

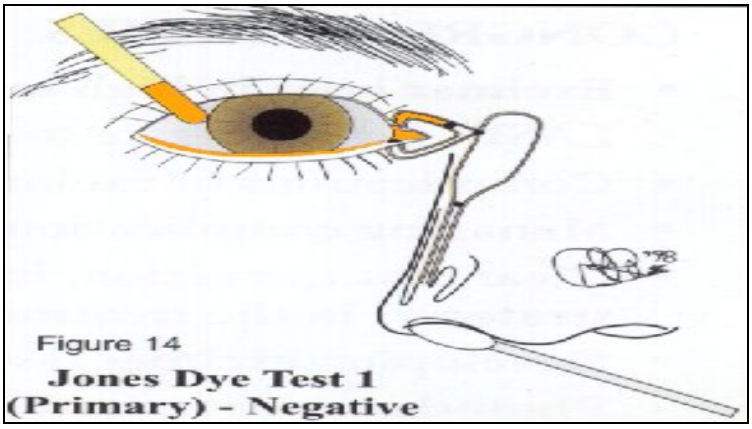
1- Primary Jones test differentiates a partial obstruction of the lacrimal passages from primary hypersecretion of tears. First, fluorescein drops are instilled into the conjunctival sac. After about 5 minutes, a cotton-tipped bud moistened in 4% cocaine is inserted under the inferior turbinate at the nasolacrimal duct opening. The results are interpreted as follows:

a) Positive: fluorescein recovered from the nose indicates patency of the drainage system. The cause of excessive watering is primary hypersecretion and no further tests are necessary.



Jones Dye Test 1- Positive[36]

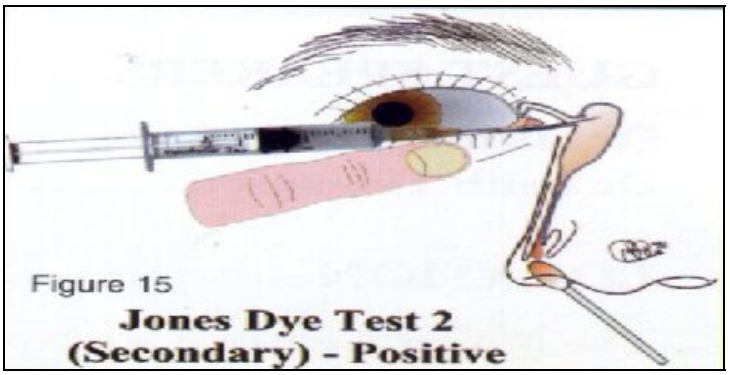
b) Negative: no dye recovered from the nose indicates a partial obstruction (site unknown) or failure of the lacrimal pump mechanism. In this situation the secondary dye test is performed.



Jones Dye Test 1- Negative[36]

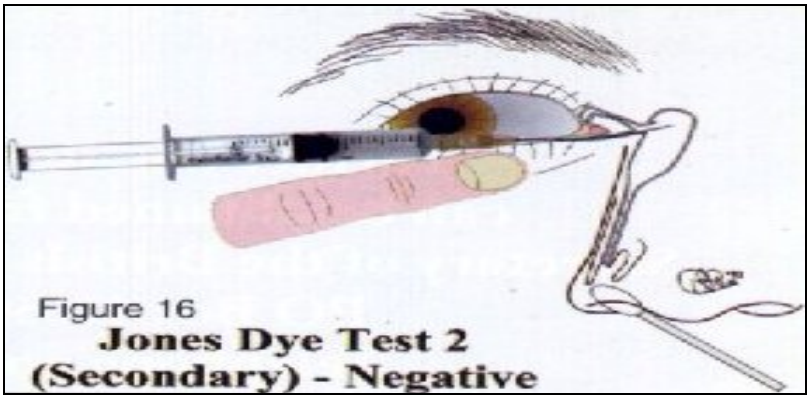
2- Secondary (irrigation) test identifies the probable site of partial obstruction. Topical anaesthetic is instilled into the conjunctival sac and any residual fluorescein washed out. The drainage system is then irrigated using clear saline and the results are interpreted as follows:

a) Positive: fluorescein-stained saline recovered from the nose indicates a partial obstruction to the nasolacrimal duct.



Jones Dye Test 2 – Positive[36]

b) Negative: unstained saline recovered from the nose indicates a partial obstruction of the upper drainage system (puncti,canaliculi, or common canaliculus) or a defective lacrimal pump mechanism . [124]



Jones Dye Test 2 – Negative[36]

- Dacryoscintigrahy (nuclear lacrimal scaning):

In this technique 10 microgram of radionuclide technetium-99 (Te99) is delivered by a micropipette to the lateral conjunctival sac. The tracer is imaged by a gamma camera projected to the inner canthus and a sequence of images are

recorded over 20 minutes. This may be useful when there is a functional rather than an anatomical obstruction at certain levels of the drainage system.[128]

b) *Anatomical evaluation:*

- Lacrimal irrigation and probing**:**

A drop of topical anaesthesia is instilled into the conjunctival sac. Punctal dilatation is the first step. A straight lacrimal cannula on a 3 ml saline filled syringe is inserted into the lower canaliculus. As the cannula is inserted deeper, an attempt is made to touch the medial wall of the lacrimal sac and the lacrimal bone. The cannula can come either to a hard stop or to a soft stop. Hard stop occurs if the cannula touches the medial wall of the lacrimal sac and the lacrimal bone. This indicates that the lacrimal sac has been entered an excludes compete obstruction of the canalicular system. The examiner then irrigates, if the saline passes into the nose the patient may have either no or partial obstruction or alternatively the cause of watering is either hypersecretion or lacrimal pump failure. Failure of saline to reach the nose is indicative of a total obstruction of the nasolacrimal duct. In this situation, the lacrimal sac will become distended during irrigation and there will be reflux through the upper punctum. In the presence of infection the saline may be purulent. Soft stop as the cannula presses the common canaliculus and the lateral wall against the medial wall of the sac. This indicates that the cannula has been

prevented from entering the lacrimal sac by an obstruction in the canalicular system. Irrigation will therefore not cause the sac to be distended. In the case of lower canalicular obstruction, there will be reflux of saline through the lower canaliculus. Reflux through the upper canaliculus indicates potency of both upper and lower canaliculi, and total obstruction of the common canaliclus. [85]

- Dacryocystography (DCG):

Plastic catheters are placed into one canaliculus on either side. Contrast medium, usually in the form of lipiodol about 1ml, is simultaneously injected through both catheters and postero-anterior radiographs are taken. Five minutes later an erect oblique film is taken to assess the effect of gravity on tear drainage. [128]

Interpretation of the test:

- Failure of dye to reach the nose indicates an anatomical obstruction, the site of which is usually evident.
- A normal DCG in the presence of epiphora indicates either a partial obstruction or lacrimal pump failure.
- DCG is also helpful in the diagnosis of diverticula, fistula, and filling defects caused by stones or tumours. [128]

- Computed tomography (CT):

Can be used if traumatic, neoplastic or mechanical are suspecting causes of obstruction. It shows any anatomical abnormalities of the surrounding sinuses and is useful for diagnosis and preoperative surgical planning.[79]

- Nasal endoscopy:

This type of evaluation can help to define any nasal factors that may impact lacrimal drainage; these include nasal septal deviation, inferior turbinate impaction, polyps, tumours, etc.[71]

Treatment:

The treatment of epiphora includes conservative treatment with antibiotics and massage. Surgical treatment includes probing, silicone intubation and dacryocystorhinostomy (DCR). It depends on the cause of epiphora .[71-74]

Conjunctivochalasis:

Treatment is indicated if tearing, irritation, and obstruction occur. Treatment may entail artificial tear drops, corticosteroid or antihistamine eye drops, or patching before sleep. More severe symptoms need surgical intervention. The techniques may include simple crescent excision of the inferior bulbar conjunctiva 6mm away from the limbus with or without amniotic membrane transplantation (AMT) to the bare area. A

peritomy with two relaxing incisions with or without AMT can also help.[129,130]

The other technique consists of the lower bulbar conjunctiva attached to the sclera with 6-0 vicryl sutures 8mm posterior to the limbus.[124]

Punctal stenosis:

Primary punctal stenosis occurs in the absence of punctal eversion. If repeated dilatation is unsuccessful one of the following procedures should be considered:

- One snip ampullotomy , in which a vertical 2mm snip is made in the posterior wall of the ampulla.
- Two snip procedure, in which both a vertical and a small horizontal cut is made in the ampulla. This yields a larger and more permanent opening than one snip procedure.
- Laser punctoplasty, in which the punctum is opened with an argon laser. This method is particularly useful in elderly patients in whom the punctum is occluded by an over growth of conjunctival epithelium.

Secondary punctal stenosis is caused by punctal eversion. Treatment, provided if there is no associated significant involutional ectropion, is by one of the following procedures:

- Ziegler cautery punctures which are placed 5mm bellow the punctum. Subsequent shrinkage of the cauterized tissue should invert the punctum.

- Medial conjunctivoplasty, in which a diamond-shaped piece of tissue is excised about 4mm high and 8mm long, parallel with and inferior to the canaliculus and punctum. Once the punctum is restored to its normal position, it is dilated so that it will remain open when normal tear flow is established. If the punctum remains stenosed,treatment is the same as for primary stenosis.

Punctal agenesis:

It is usually associated with the absence of underlying canaliculr tissue. Where both puncta are absent, inspection of the internal opening of the common canaliculus at surgery is recommended and if no canalicular tissue, a lester-Jones tube is inserted.[54]

Patients who have punctal stenosis as a result of systemic use of 5-FU for colon and breast cancers are treated with either silicone tubes or with conjunctivo - dacryocystorhinostomy (CDCR). Early recognition and treatment of tearing in patients on 5-FU with silicon tubes may salvage the canalicular system and prevent the need for CDCR. [131-133]

Canalicular problems:

In case of a circumscribed canaliculus stenosis, the scars may be removed by excising the scar tissue and by anastomising the canaliculus with micro-sutures. In stenosis of a common canaliculus, a retrograde probing from the lacrimal sac will be

necessary. After opening the lacrimal sac as in an external DCR procedure, the internal opening of the common canaliculus may be detected microscopically and a dissection of the scars can be performed following retrograde probing.[134-137]

In severe cases, where complete proximal canalicular system is scarred; only a CDCR or some other types of bypass surgery can be performed.[138-141] Endoscopic laser treatment combined with silicone intubation enables to recanalise presaccal stenosis of canaliculi under local anaesthesia up to a scar thickness of 2.0mm. Best results can be achieved in cases where much tissue can be saved. Under such conditions this procedure can substitute for more invasive surgical techniques, especially a CDCR.[142] New approaches to canalicular problems have been developed in the last decade. These approaches are geared mainly toward trying to preserve the natural anatomical drainage pathways rather than proceeding directly to bypass the affected area.[71] One of such technique is silicone intubation after microtrephination which is done mechanically or with laser.[71,143]

The intra-operative use of a mitomycin-c (MMc) soaked pledget.[144] or postoperative MMc eye drops (0.2mg/ml)[145] increases the effectiveness of the microtrephination technique by decreasing scarring. This technique of scar removal with the microtrephine or laser coupled with silicone intubation for 3-6 months has a variable success rate of approximately 20% to 60%.[146,147] Recent reports have suggested that trephination

followed by dilatation for common canalicular obstruction (CCO) with a ballon catheter dilatation may help to open canalicular obstruction. The length of the occluded canalicular segment limits the effectiveness, as the small balloon catheter is only 2mm wide. The technique of endoscopic canaliculo-DCR with two silicone tubes has been applied to common canalicular obstruction or proximal individual canalicular obstruction with a 76% success rate. This rate is not as high as that reported with the use of double silicone intubation for persistent congenital nasolacrimal duct obstruction in children.[148,149]

Canalicular stenosis secondary to weekly therapy with docetaxel in patient with metastatic breast cancer should be treated with bicanalicular silicone intubation early in the course of docetaxel therapy. Failure to treat this adverse effect early may likely lead to severe inversible canalicular stenosis, which may necessitate CDCR with the placement of a permanent pyrex glass tube.[150]

Treatment of lacrimal sac disorders:

- Acute infections need oral antibiotics with broad spectrum eye drops and lacrimal massage which may be adequate for early stage. Warm compresses to the area several times a day may also helps. If a fever is present or if the infection is severe, intravenous antibiotics may be required. The type of the antibiotic depends on the suspecting infecting agent or the results of cultures and sensitivities. Although Actinomyces organisms are sensitive to penicillin, it usually requires complete removal of the canalicular stones for complete treatment.[127] If abcess, is formed, incise and drainage of it is performed. Patient with their fifth or sixth episode of painful acute dacryocystitis, having refused recommendations for DCR, the lacrimal sac is fibrotic and shrunken and contains sequestered pockets of purulent material; need to supplement oral antibiotic treatment. One can use regional intramuscular and intralacrimal sac antibiotic injections (e.g, gentamicin, 40to 80 mg). The injection itself is quite painful, thus lidocaine 2% should be infiltrated before injection of the antibiotic. Thus local use of intramuscular antibiotics is very helpful in those cases that are difficult to treat them and may spare patients from the need for intravenous therapy. Both the physician and patient should view the medical managment

of acute or chronic dacryocystitis as a temporary, palliative treatment. DCR is the definitive curative treatment of choice.

- Lacrimal fistula is treated by surgical excision of this congenital fibrous drainage tract of the lacrimal sac.[151] Irrigation or probing should be used to confirm its patency.
- Dacryocystocele is treated by external digital pressure on the cyst may enable the contents to decompress through the nose. If this is unsuccessful, probing with inferior turbinate outfracturing is the treatment of choice.[152] Dacryocystocele and dacryocystitis benefit from early probing. This is in contrast to the usual conservative measures of warm compresses, downward massage and antibiotics used for all other neonatal lacrimal system disorders. By relieving the obstruction, atony of the sac and disruption of the medial canthal musculature and skin are prevented preserving the lacrimal pump mechanism. Furthermore left unaltered, the fluid-filled sac is at a higher risk of infection, secondary scarring and permanent closure, requiring a more involved surgical bypass procedure (dacryocystorhinostomy).[64]
- Lacrimal sac tumors: are treated by complete excision which is the treatment of choice for epithelial tumors of the lacrimal sac. This excision should include the

canaliculi, lacrimal sac with mass, and an appropriate amount of the nasolacrimal duct. This surgery can be performed with local anesthesia through a standard DCR incision, a confirmatory biopsy with frozen- section analysis is performed. If the biopsy sample indicates a lymphocytic process (e.g lymphoma), then no further surgical excision is necessary. Complete dacryocystectomy is indicated for epithelial lacrimal sac tumors or other nonlymphocytic malignancies. Radiation treatment is not curative but may be useful as adjuvant therapy.[118]

Treatment of the nasolacrimal duct obstruction:

Treatment of the nasolacrimal duct obstruction includes conservative treatment with antibiotics and massage.

Surgical treatment includes probing, silicone intubation and dacryocystorhinostomy.[7,60,131,132]

Congenital nasolacrimal duct obstruction is spontaneously resolved in 90% of cases during the first year of life[60].

a) Medical or conservative treatment:

External nasolacrimal massage using the creiger maneuver, in which one finger is placed over the common canaliculus to prevent regurgitation and use another finger to rub downwards. Ten strokes, four times a day is recommended along with warm compresses twice daily. The massage creates hydrostatic

pressure to open the nasolacrimal duct .Using this technique resolve 54% of cases by 6 months of age, and another 17% of cases resolve by 12 months of age.[153] The infant has epiphora and mattering but no evidence of infection, prescribe warm compresses; topical broad spectrum antibiotic drops and lacrimal sac massage.[154] The purpose of antibiotic is not to cure the blockage, but to minimize the risk of infection until there is spontaneous resolution or until a more definitive therapy used.[154]

b) Surgical treatment :

- Bowman probing cures 95% of congenital nasolacrimal obstruction, and has a significant decrease in effectiveness with the increasing number of probings and the age of the patient.[55]

  The success rate at the age of 12 months or less is 92% whereas the success rate at the age of 18 months or older is only 50%, so it generally avoided after 12 months of age.[155] It is easy and safe to have general anesthesia by endotracheal intubation. This facilitates mobility and convenient in intranasal examination and manipulation, which otherwise would be impossible with facial masks. Both upper and lower puncta are dilated with punctum dilator. All the contents of the lacrimal sac are irrigated. Probing is done through the upper punctum, usually No.0 and No.1 sized Bowman probes are used while the use of

finer probes can lead to false passage, larger probes can cause damage to the puncta. The probe is lubricated with sterile ophthalmic ointment and passed into the upper canaliculus. It is useful to remember that the first 2mm of the canaliculus is vertically oriented. Hence, this should be the initial direction of the probe. Later, the probe is passed horizontally along the canaliculus as far as the medial wall of the lacrimal sac in order to touch the bone. The probe is then directed downward, backword and laterally towards the upper second molar tooth. It is useful to remember to pass the probe along the bony resistance. A membranous or fibrous obstruction will be felt to give way. The intranasal portion of the probe can be palpated with the largest sized Bowman probe passed along the lateral wall of the nose in the inferior meatus. The same probe can be used to in fracture the inferior turbinate. Following probing topical antibiotic drops and sac massage are continued for 2 to 3 months even if the symptoms subside.[122]

- Nasolacrimal intubation: it has been advocated as an alternate procedure to DCR in children who have failed probing. Success rate of 80-95% have been reported, but most patients have only been probed twice or less and are younger than 2 years. Prognosis is poor for those patients with previous dacryocystitis and for those patients in

which an obstruction is encountered during the procedure.[156] Lim et al recently noted that increasing duration of intubation was not associated with increasing chance of success but with a significantly higher risk of failure if longer than 18 months. The retention of stents for longer than 12 months was associated with a significantly lower success rate (67%). The presence of Down syndrome, older age at the time of surgery, and gender of the patient were not predictive factors for treatment failure. The unplanned removal of the tubes because of dislodgement was the most common complication, occurring in 25% of eyes, but did not affect the functional outcome.[157]

- Balloon catheter dilatation of nasolacrimal system with or without silicone tubing: this procedure has slightly better results than intubation alone. Most probing failures occur as a result of upper sac or mid duct obstruction and are not amenable to cure by instrumentation.
- Dcryocystorhinostomy (DCR): DCR consists of creating a direct connection between the tear sac and the nose, bypassing the blockage and allowing the tears to drain normally again.[6] The indication for DCR is, secondary unacceptable epiphora caused by an atonic or functional lacrimal sac (lacrimal pump failure), nasolacrimal duct obstruction, chronic dacryocystitis with purulent

discharge from the canaliculi, dacryolith formation and benign lacrimal sac mass.[20] The contraindications for DCR are, dry eye syndromes, bleeding dyscrasis and other systemic deficiencies that would jeopardize surgery.[20]

It has the following methods:

- External DCR in which the lacrimal sac is approached from outside via a short skin incision, a little bit of bone between the tear sac and the nose is removed in order to reach inside the nose, the tear sac is opened and stitched to the lining of the nose (nasal mucosa), a soft silicone tubing is placed from the upper and lower puncti though the tear ducts into the nose temporarily to keep the passage open. These tubes are usually removed between six and eight weeks after the operation. [130]
- Internal DCR in which the lacrimal sac is approached via inside the nose, with the use of endoscope. [6]

  The internal DCR has two procedure: internal DCR with the use of endoscope alone, which is entirely surgical[112] and internal DCR with the use of endoscope and laser to create a rhinostomy.[6,7,8,9,10]

  - Endoscopic non laser DCR: involves the creation of a large ostium and construction of nasal and lacrimal sac mucosal flaps.[158] The technique is appropriate for initial treatment of patient with common canalicular or even canalicular obstruction. It is highly suitable for

revision operations for two reasons. Firstly, most of bone removal has been performed at the initial operation, secondly,where the previous operation was an external DCR, the scarred tissue planes of the orbit and lateral wall of the sac are avoided.[159]

- Endoscopic laser assisted DCR: Endonasal laser-assisted dacryocystorhinostomy (ENL-DCR) using KTP laser (potassium-titanyl-phosphate laser) appears to be an efficient technique with low complication rate and it is well tolerated by the patients.[160] The endoscopic laser- assisted DCR has advantages such as that there is no skin incision, less bleeding, and faster recovery.[126] Reported primary ENL-DCR success rate vary from 68% to 99%,[20,21,161] depending on the type of laser, the size of the osteotomy and the use of antimetabolities, such as mitomycin C.[162]

The endoscopic approach has several advantages including the following:

No external scar, allows a one-stage procedure to correct also associated nasal pathology that may be causative, it avoids injury to the medial canthus and/or pathological scar formation, it preserves the pumping mechanism of the orbicularis oculi muscle, active infection of the lacrimal system is not a contraindication to surgery, it is superior to the external approach in revision surgery, it is much less bloody and messy than the external approach and the perioperative time is shorter

because of the facility of the approach.[20] This endoscopic surgery requires specialized training in nasal endoscopic surgery and the endoscopic equipment is an expense. It is difficult to make definite evidence-based determinations about the relative efficacy of endonasal and external DCR because of the deficiencies in the reported literature.[157] Some studies comparing endonasal DCR with external DCR suggested lower success rates in the endonasal group. Other studies yielded success rates comparable with or exceeding those of external DCR.[157]

The other type of DCR is the conjunctivodacryocystorhinostomy which is performed in cases of paralysis of the lacrimal pump system, absence or obliteration of canaliculi, when the site of obstruction is proximal (punctum, canaliculi and lacrimal sac), congenital malformation, cicatricial conjunctival disease, chemical burns, irradiation, and tumors of the lacrimal sac.[158] The upper system can be bypassed using prosthesis, such as a Lester-Jones tube. This procedure probably should be avoided until the child is older than 10 years because the prosthesis requires care from the patient and often has minor complications and revisions. In punctal agenesis where no canalicular tissue can be identified, the insertion of a Lester-Jones tube is necessary.[56]

For each method there are advantages and disadvantages.[9,158]

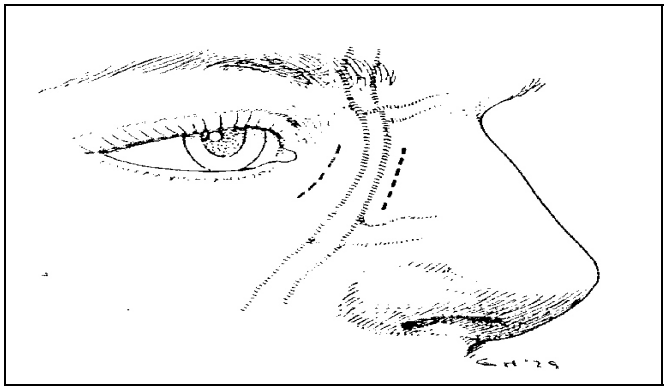
In this thesis the focus will be mainly on the external method of DCR (the only method done in AL-Thawra hospital) as a successful therapeutic method in childhood and adults when medical therapy, probing and silicone intubation have been unsuccessful.[130,163]

EXTERNAL DACRYOCYSTORHINOSTOMY

External DCR is still the most popular procedure done for nasolacrimal duct obstruction and the gold standared by which other methods are measured and compared. It is indicated if the conservative procedures described are unsuccessful, or if there is obvious bony obstruction below the lacrimal sac.[164, 165]

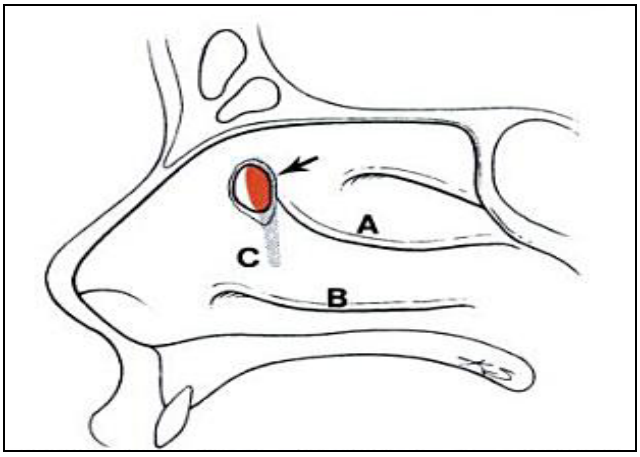
Operative technique:

The local anesthesia can be used in adult. After the eye on the operative side is topically anesthetized with proparacaine hydrochloride, infiltrate subcutaneously lidocaine 2% with epinephrine (1:100,000) in the operative area below the medial canthus and in the region of the infra-trochlear nerve above the medial canthus. Packing gauze, 0.5 inch wide and 6 to 8 inches long, saturated with 5% cocaine and a trace of epinephrine hydrochloride (1:1000) or phenylephrine 2% is packed into the nose in the region of attachment of the anterior tip of the middle turbinate. When general anaesthesia is used, the same infiltration and nasal packing are employed. This treatment will shrink the nasal mucosa and reduce hemorrhage as well. Patient may need hospital admission or to be done on a day surgery base.[166]



The choices of landmarks of skin incision, medial or lateral to the angular vessel [168]

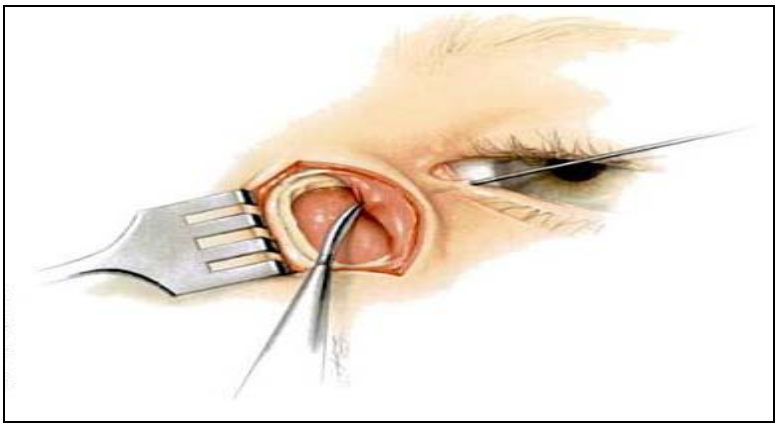
The skin incision is calculated to avoid the angular vessels and provide adequate exposure. It may be placed close to the canthus, (2-4mm) from the inner canthus, over the anterior lacrimal crest, or farther on the nose, 11 mm from the inner canthus on the other side of the angular vessels (angular vessels are located about 8 mm from the inner canthus). In reality angular vessel bleeding is the least troublesome bleeding encountered and often can not be avoided regardless of placement of the incision, it is easily stopped with proper exposure of the vessels .The incision should be as straight as possible to avoid a bowstring of the wound . Incision done with a No.15 Bard-Parker scalpel blade, then the subcutaneous soft tissues and the orbicularis muscle is carefully bluntly separated with scissors down to the periosteum.[167] The angular vessels are reflected medially with the orbicularis muscle by small rake retractors or a self- retaining retractor. If these vessels are cut, they can be cauterized.



Saggital view of the DCR ostium (arrow). (A) Middle turbinate; (B) inferior turbinate; and (C) nasolacrimal duct [168]

The periosteum and the lower half of the anterior limb of the medial canthal tendon were incised and reflected with a periosteal elevator to expose the lacrimal sac fossa.[2] The bony opening historically was first made with an osteotome and mallet; recently, more precise instruments are now used to make the initial osteotomy, such as a high-speed drill. However, a hand trephine (Arruga type) of 10mm diameter can be used to drill dowen to the nasal mucosa. There are two trephines, one with a sharp central point and coarser teeth to engage the bone and create the initial cut, and a liner-toothed trephine that can be worked more gently down to the level of nasal mucosa. The circle of bone can be removed with a fixation forceps. It is peeled off of the nasal mucosa gently, with the use of a freer

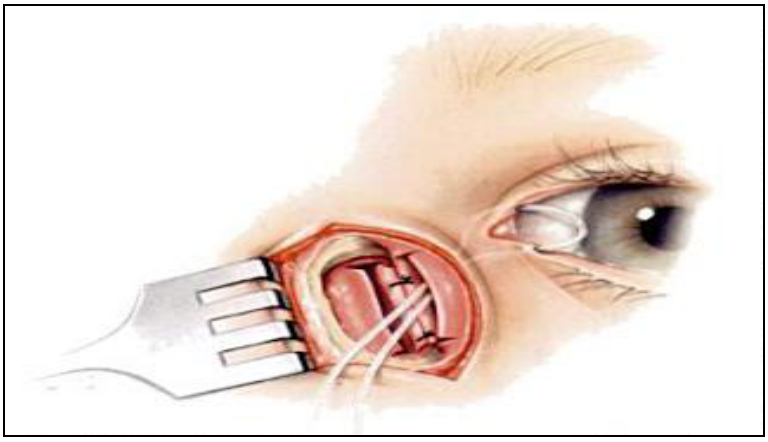
periosteal elevator. Hall air or mallet and osteotome are alternatives for gaining entrance through the bone to the nasal mucosa. After either method of initial osteotomy, the bony opening must be enlarged from 1.5 to 2 cm with side-bitting punch (rongeur or nippler are other names). The bony opening straddles the anterior lacrimal crest and should be anteriorly and inferiorly placed and large. Closure of the intranasal ostium is an important cause of failure of DCR.[139] This opening should be made with preservation of nasal mucosa. The lacrimal sac is identified beneath the periosteal layer, which has been reflected laterally, by placing a probe into canaliculus to point up under the periosteum. The sac can be entered with a scalped blade, by cutting directly over the probe, or by cutting the sac with angled scissors. Cutting also can be done at the entrance of the sac to the nasolacrimal duct. This step is facilitated by prior removal of the medial wall of the nasolacrimal duct. One blade of the scissors is passed into the opening created at the top of the duct, and the sac is divided from a superior to an inferior direction. The most important flaps are the anterior flaps from the sac and the nasal mucosa because the posterior flaps will fall together easily and epithelialize. [167]



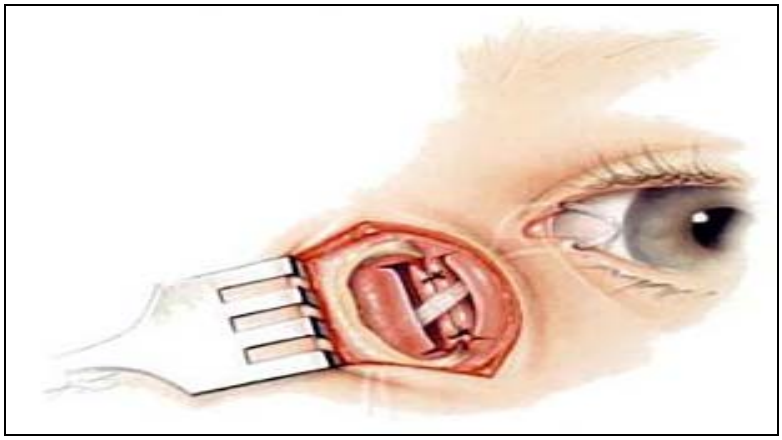
Creating mucosl flaps. A vertical incision is made in the lacrimal sac to create anterior and posterior nasal mucosal flaps. Because of its angulation, a #66 Beaver blade is useful in this portion of the procedure. It can also be used to create a vertical incision in the nasal mucosa to create anterior and posterior mucosal flaps [168]

A wide variety of ways have been performed to carry anastomosis between the sac and nasal mucosa. In patients with anterior flap anastomosis, an H-shaped incision is made in the lacrimal sac and a U-shaped incision is made in the nasal mucosa. The sac is opened from the upper limit of the fundus down into the proximal nasolacrimal duct. The posterior flap is completely resected and sent for pathological examination. In patients with anterior and posterior flaps anastomosis, a horizontal H-shaped incision is made in both tissues. Flaps are trimmed and sutured together using 6-0 plain catgut.[2] An alternative method recommended by McCord is to create a large posterior flap of nasal mucosa by incising the nasal mucosa high and folding it down to meet a short posterior flap of lacrimal sac, the anterior flap is formed entirely of lacrimal sac.[169] The incision into the lacrimal sac is made very posterior so that a

large anterior mucosal flap is created, the flap can be sutured to the remaining anterior nasal mucosa or to periosteum at the end of the bony opening. This method is also useful if the nasal mucosal flap has been damaged or inadvertently cut near the top of the bony ostium. DCR also has been done without forming any flaps.[170] The common internal punctum should be examined carefully by passing blunt probes through this structure through each canaliculus. Most patients have a true shared internal entrance of the canaliculi, but occasionally, there may be separate normal puncta. Any scars or obstructions of this area must be excised with scissors, and a new common opening created by itubating the canaliculi with silicone tube. [168]



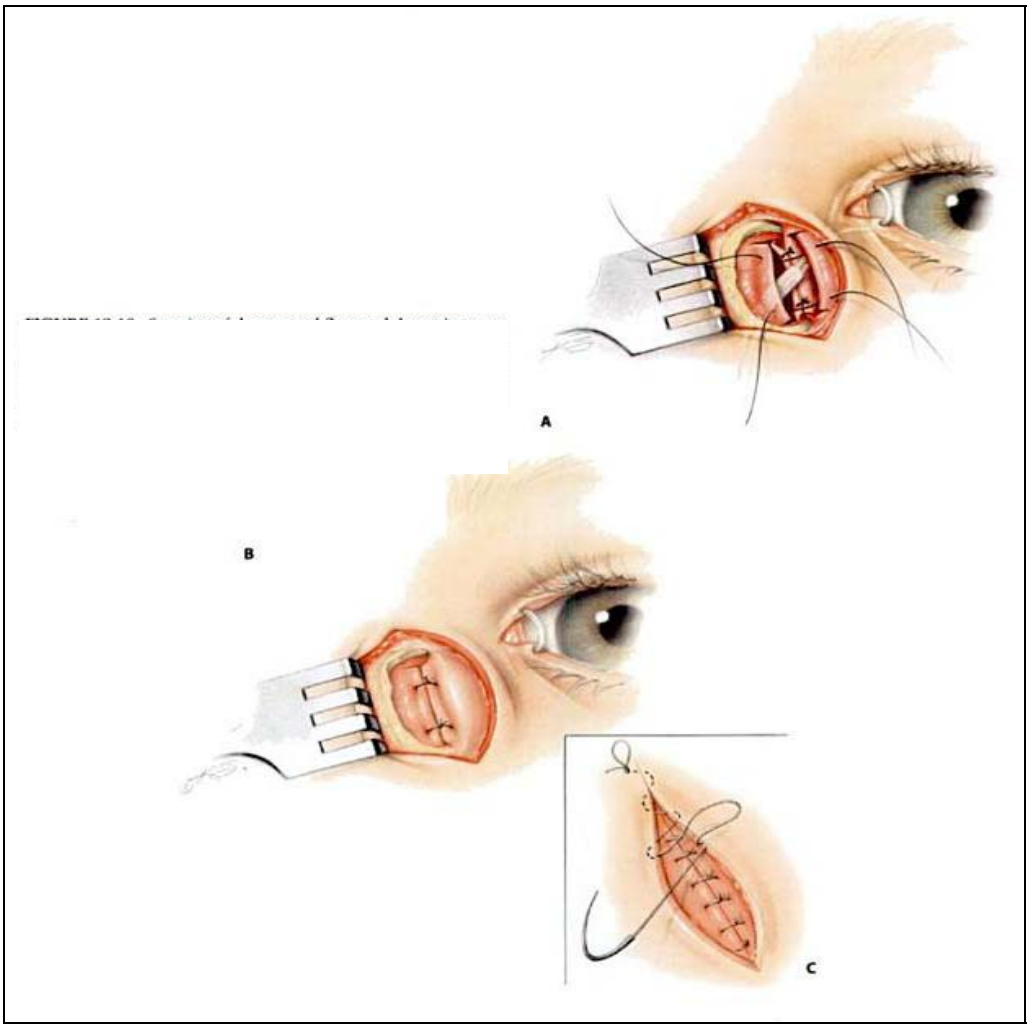
Silastic tubes. Silastic tubes are passed through the puncta, sac, and DCR osteotomy and brought out through the wound [168]



Fixation of the silastic tubing. Each probe with tubing attached is passed through a length of larger bore Silastic, which creates a noose effect for securing the loop of tubing. The loop should be loose enough to pull halfway to the corneal limbus without tension. The probes are then removed and multiple knots are tied at the appropriate tension. The excess Silastic ends are cut and the knot and cuff are allowed to retract into the nose. [168]

Silicone tube bonded to a probe is passed through each punctum and canaliculus to emerge from the internal common punctum. The metal probes are pulled free from the ends of the tube. Intra-sac fixation suture is done to minimize the risk of lateral displacement of the tube and allows careful adjustment of stent tension at the puncta.[104,171] The ends of the tube are pulled out of the nose to estimate appropriate tension of the loop at the medial canthal area. A small curved hemostat passed up the nose from the external nares is useful for grasping the ends of the silicone tube to pull them inferiorly. Once the appropriate tension is achieved, multiple surgical knots that is large enough to block inferior displacement and loss of the tube. The silicone tube is then stretched from the nose under moderate tension and cut, so that the ends remain long enough, but short enough that

when cut, they will retract high enough to be invisible externally. Aside from a slight sense of nasal stuffiness, the presence of the tubing presents no post operative problem to normal nasal breathing. The anterior flaps of the lacrimal sac and nasal mucosa are joined with interrupted 4-0, 5-0 or 6-0 absorbable sutures (as vicryl). If the nasal mucosa has been damaged and is insufficient for closure, a larger anterior flap of the lacrimal sac should be fashioned and sutured directly to the periosteum at the medial edge of the bony ostium. If the anterior flap of nasal mucosa is too large and there is a risk of causing obstruction, it should be trimmed conservatively. The muscle (orbicularis) and subcutaneous tissues are closed with interrupted 6-0 absorbable sutures, and the skin is closed with a running subcuticular 5-0 non-absorbable (as silk or nylon) suture. Erythromycin or an antibiotic/steroid combination ointment is placed on the incision,[7] which is then covered by a mild pressure dressing for 12 to 24 hours. [167]



Suturing of the mucosal flaps and the periosteum. (A) Both posterior nasal and lacrimal sac mucosal flaps are sutured with interrupted 4-0 chromic or Vicryl sutures. (B) The anterior flaps are sutured above the Silastic tubing. (C) inset shows a running 5-0 nylon subcuticular suture closure of the DCR incision site [168]

Post operative care:

Patients are cautioned not to blow their nose as this will increase the chance of epistaxis.[7] After one week he can blow his nose to get rid of clots. On the first day after surgery an eye pad should be removed and clean the eye and the wound. If there is nasal pack it should be also removed and if there is

bleeding the patient sit up, and swallow or spit any small clots out. If this persists the end of the nose should be held tightly, but the bleeding is rarely requires a return to the operating theatre.[130] Antibiotics ointment or drops usually applied to the conjunctival clu-de-sac at bed time only during the first week postoperatively with appropriate systemic antibiotic, which can be given inravenously during the procedure and continued for 3 days postoperatively. The skin sutures can be removed on 5 to 7 days postoperatively. The silicone tube is usually removed between 6 and 8 weeks after the operation.[7,130]

The success rate of external DCR has been reported between 80% and 99% depending on the surgeon,s experience.[7] There are many factors affecting the results of DCR in general. The success rate was increased with intra-operative application of mitomycin C.[10,172,173] However, other studies showed the success rate was between 88% and 93% depending on the site of obstruction.[159] Failure of external DCR have been attributed to many factors including pre-operative risk factors such as previous trauma, common canalicular obstruction, intranasal pathology, previous nasal surgery with nasal scarring and some elements of mucosal blockage.[9] Intra-operative risk factors such as per-operative bleeding, site and size of the ostium, and anteropositional of anterior ethmoidal air cells,[9] so the frequency of entry into the ethmoidal sinus as opposed to the nose has been highlighted emphasizing the importance of

adequate knowledge of the nasal anatomy while performing external DCR.[174] Post operative soft tissue infections,[3] scarring within the anastomosis or non-absorbable suture material and persistent mucocele are other factors which increase failure rate.,[175,176,177] However study indicated that the functional outcome of DCR was related to the size of rhinostomy after the surgery which is markedly reduced and another one said that the outcome was related to the eye lid condition.[178,179] However the most important complications encountered in this type of surgery include the following: during surgery, apart from the complication of anaesthesia, excessive bleeding.[158] injury to the medial canthal structures and cerebrospinal fluid rhinorrhoea may occur.[3] Acute angle glaucoma was reported following the use of intra-nasal cocaine during the operation in the predisposed individuals.[180] Post operative pain, epistaxis, hematoma, delayed wound healing, accidental removal of tubes[158] and delayed failure of DCR due to closure of the rhinostomy may occur.[179]

Repeated Dacryocystorhiostomy:

The two most common causes of DCR failure are common canalicular obstruction and obstruction at the rhinostomy site.

Lacrimal out fllow irrigation can differentiate between these two problems. A common canalicular blockage typically elicits pain on attempted irrigation, as well as direct regurgitation of fluid from the canaliculus being irrigated. If the common

canaliculus is patent and the rhinostomy site is blocked, fluid irrigated through the lower lid canaliculus collects in the residual lacrimal sac and refluxes from the upper punctum. During repeate DCR, the anterior crus of the medial canthal tendon is incised to gain full exposure of the fundus of the lacrimal sac. The surgeon should dissect anterior to the prior rhinostomy site to expose virgin nasal mucosa. This virgin nasal mucosa then incised in a way that affords inspection of the internal aspects of the previous rhinostomy site. Bone, scar tissue, ethmoidal air cells, dacryoliths, or an adherent turbinate may be revealed as the cause of initial DCR failure. In some patients, the intranasal ostium may simply have closed. In a series of 22 DCRs, Linberg and colleagues documented that surgically created ostia (average 11.84mm in diameter) undergo dramatic narrowing during the first few months of healing (average 1.80 mm in diameter after surgery).[181] Thus complete ostium closure remains a frequent concern among DCR failures. Then, anterior and posterior flaps of lacrimal sac and nasal mucosa are carefully anastomosed. By incision of the anterior curs of the medial canthal tendon (performed earlier in the reoperation), good flaps can be fashioned both superior and inferior to the common canaliculus. In reoperation DCRs, the lacrimal sac or nasal mucosa or both may be deficient. Full-thickness buccal mucous membrane grafts may be used to create flaps in these especially difficult cases.

Mitomycin C inhibits fibroblast activity during wound healing and has well-established uses in ophthalmic surgery. More recently, its use has been investigated in DCR surgery[24,182] More long-term studies are needed, but adjunctive treatment with mitomycin C offers the potential of increasing DCR success rates in select cases by combating the mechanism of distal canalicular and osteotomy fibrosis and scarring. The effect of fibrovascular suppression appears to be dependent on the concentration of the drug, the duration of the topical application, and other factors such as surrounding tissue inflammation and vascularity. Although a small study showed when Mitomycin C applied (in dose of 0.2 mg / ml) by cotton pledget to the ostium site intra-operatively, this increase the success rate (SR) of Ext-DCR significantly, and proved its safety over a mean follow up of 35 months.[162] In DCR failures due to distal rhinostomy site obstructions, post-DCR nasal endoscopy may reveal adhesions between the rhinostomy site and nasal septum or turbinates, which can be treated by intranasal lysis of synechiae. Intranasal endoscopy may reveal also pyogenic granulomas occluding the rhinostomy site; these can be treated with corticosteroid nasal sprays.[183] A small study done in USA, by doing endoscopical examination for 12 patients with failed DCR revealed that, retained stenting materials in 6 patients (when removed endoscopically the condition improved), 3 patients with small bony ostium, 2 patients with excessive scar formation in

the ostium and patient with improper position of the ostium.[183] Lastly Ballon Dacryo-plasty (DCP) have been introduced in UK, as an alternative for DCR with promising SR of 89%[183,184] and in 2003 a retro-canalicular approach (from behind the conjunctival caruncle) have been used for DCR with a SR 85% with a mean follow up of 2.8 months only.[181]

Objectives

General objectives :

- To study the outcome of external DCR in order to determine the factors affecting its results, so as to improve its outcome.

Specific objectives :

1- To estimate proportions of external DCR done in Sana'a by age , sex and cause .
2- To estimate the rate of success and failure of external DCR in each category .
3- To identify the factors leading to failure of external DCR in each category .
4- To provide data to compare with other studies .

Chapter TWO

Methodology

1- *Study type :*

This is a prospective study that will include one hundred twenty patients who have been diagnosed as having nasolacrimal drainage obstruction and booked for surgery.

2- *Study area :*

The study will be done in the Department of Ophthalmology at Al-Thowra Hospital which is one of the largest hospitals in Sana'a and is considerd as the main referral hospital.

3- *Study population :*

All patients attending Al-Thaowra Hospital with epiphora due to nasolacrimal duct obstruction who are eligible for surgery and are booked for operation during the study period.

4- *Variables under study :*

- Pre-operative :

Age, sex, cause of obstruction of the nasolacrimal duct and presence of inflammation, fistula or scarring .

- Operative:

Site and size of skin incision, site and size of osteotomy, condition of the sac, availability of flaps both nasal and sac flaps, deviated septum, position of the anterior ethmoidal air cells, intra- operative bleeding and other difficulties.

- Post-operative:

- **First day after surgery:** status of the tubes, status of the wound and presence of bleeding.
- **One week after surgery:** presence of complications such as infection, dislodgment of tubes and trauma .
- **Six months after surgery:** recurrence of epiphora and evaluation of DCR patency by syringing test.

5- Data collection tools :

Six forms were designed for collection of data from the study units. Form one was for Pre-operative findings including questions (symptoms) and observations (signs) detected on clinical examination and lab findings (see form attached). Form two was for intra-operative findings including observations and findings detected by the surgeons during the operation. Form three was for findings detected post-operatively, this was filled in four phases. The first one was for the first day after surgery, the second one was for the seventh day after surgery, the third

one was for two months after surgery and the fourth one is for six months after surgery.

6- Study tools:

The following tools were used to examine, investigate and operate on the Patients:

1- Pen light (torch).
2- Slit-lamp.
3- Bard – Parker blade holder.
4- Blades, size 11 and 15.
5- Nasal bayonet forceps.
6- Fine and Heavy toothed forceps.
7- Nettleship's punctum dilator.
8- Bowman's lacrimal probes from size 0 to 8.
9- Lacrimal cannula straight and curved.
10- Hemostat (artery) forceps (curved and straight).
11- Mosquito forceps.
12- Bone Punches = Rongeurs = Nipplers (Citelli and Kerrison) .
13- Nasal speculum.
14- Lacrimal retractor (Stevenson).
15- Freer's periosteal elevator.
16- Suction machine with sterile tubing and tips and calibrated glass bottle.
17- 4/0 silk suture (for traction and skin).
18- 6/0 vicryl suture (for flap and subcutaneous tissues).

19- Blunt curved scissors (as: tenotomy or Wiscott's scissors).
20- Silicon tubes.

7- Pre-operative Preparations:

Diagnosis depend on history of epiphora, regurgitation test, lids examination , nasal examination, probing and syringing. None of the patients was subjected to Schirmer,s test, Jones test or dacryocystography , because simple regurgitation, syringing and probing provided ample proof of level of blockage in the lacrimal system . A written consent was taken from all patients .

General assessment of the patient by sending him or her to medical doctor for general examination and medical fittness for general anesthesia one day before the surgery as all surgeries were done under general anaesthesia . Complete ophthalmic examinations were performed including visual acuity , corneal opacities or ulceration and other ocular co-morbidities like glaucoma and eye lids abnormalities were looked for .

8- Operative technique:

In our study the DCR surgeries were done by three surgeons .

a- Anesthesia: All patients were subjected to general anesthesia in this study (GA). Some patients were injected by one ml of [Lidocaine Hcl 2% with epinephrine (1: 100.000)] subcutaneously under the site

of the planned skin incision to create tissue oedema that aids haemostasis, which is an important factor in DCR.

b- Facial and skin painting with antiseptic solutions (Iodine followed by spirit) on the theatre table .

c- Packing gauze with average 1 cm wide and 50 cm long saturated with [Lidocaine Hcl 2% with epinephrine (1:100.000)], is packed into the nose towards the lateral nasal wall aiming to fill middle meatus cavity. Other patients were packed with gauze soaked with tetracycline ointment for nasal packing. Elevation of the patient's head 15° (anti-Trendelenburg position) were done as routine.

(The use of lidocaine and epinephrine in the subcutaneous injection and nasal packing depend on the anaesthetist permission) .

d- Incision: The incision was done 11mm from the inner canthus over the anterior lacrimal crest. The surgeon stretches the skin over the anterior lacrimal crest, starting an incision at a level just over the medial palpelral ligament. The incision was extended downward for 1.5cm and upwards for 0.5cm with a Bard-Parker knife No. 15 blade. The incision should follow a skin fold. Traction sutures with 4/0 silk was used to aid exposure and hemostasis. Orbicular fibres

were bluntly dissected down to the periostium and the periostium cleaned over the anterior lacrimal crest with tenotomy (or Wisscott) scissors. Suction is used to clean the area. Bleeding points were gently clamped or gentle direct pressure applied, particularly when the angular vessels or branches of these vessels had been served. The blade is then placed on the anterior lacrimal crest and the periostium was cut vertically.

e- **Elevation of the sac:** using the Freer's periosteal elevator, the periostium with the sac attached to it, was then reflected laterally away from the lacrimal fossa.

f- **Making the osteotomy:** with the Freer's elevator or a curved haemostat (artery forceps), a gentle steady pressure was applied to the suture just posterior to the lacrimal bone, aiming to infracture the bone of the lacrimal fossa. Thereafter the bony opening is enlarged with Kerrison or Citelli bone punches. The opening used to range a minimum of 1.5 × 1.5 cm in size. It should be round in shape.

g- **Making the mucosal anastomosis:** after a sufficient amount of bone had been removed, attention was directed back to the lacrimal sac. A Bowman probe is inserted through the inferior punctum and canaliculus and pushed into the sac in the direction of the osteotomy opening. Tenting is observed and a cut down

into the sac through this tented portion is made with a No.11 Bard-parker blade. The stab wound should be enlarged above and below with scissors. As the sac was opened, the anterior mucosal flap is grasped and reflected anteriorly so that an inspection of the interior of the sac and the common internal orifice can be done. The sac was inspected for dacryolith, polyps and tumours. Then an H-shaped incision was made in the lacrimal sac and a U-shaped incision was made in the nasal mucosa to form the anterior flap. The posterior flap was completely resected. Silicone intubation was done through the upper and lower puncti after moderate dilatation of the puncti with the punctal dilator to allow the tip of the leader probe of the silicone intubation set to be inserted through the puncti. Silicone tube was inserted and tied with several knots in the lacrimal sac area and in the nasal cavity near the external nostril without fixing it to the nasal wall. Then the anterior flaps of both the sac and the nasal mucosa were united together with two or three vicryl 6/0 sutures. After the anastomsis between the sac and nose was completed , the retracting silk sutures were removed and the periostium, orbicularis fibers and subcuticular tissues would fall together. Several vicryl 6/0 sutures were used to approximate these tissues. The skin closed with

continuous sutures 4/0 silk. A moderately firm dressing was applied. The pack was removed in the first postoperative day. The skin sutures were removed after seven days. Then postoperative drugs prescribed in the form of antibiotic eye drops and ointment at night, systemic antibiotics and decongestant nasal drop for one week post operatively. Follow up visits were scheduled as one week, two months and six months after surgery. Six months after surgery, silicone tube was removed and the lacrimal passages were irrigated . The tube was removed by cutting it between the puncta and by either blowing the nose or by extracting the tube from the nose with forceps. The patency of the lacrimal passage was investigated by irrigation. A successful outcome was defined as resolution of symptoms like epiphora, discharge and a patent lacrimal system on irrigation.

h- Complications: The complications which had been reported were:

- Operative.
  - Hemorrhage.
- Postoperative (early in the first 24 hours):
  - Pain .
  - Hemorrhage.
  - Epistaxis.

- Postoperative (late):
  - Wound infection.
  - Recurrence of epiphora.
  - Disfigured scar.

Follow up:

If there was epistaxis nasal packing, might be needed, post-operative wound sepsis, orbital emphysema. Epiphora and scar disfigurement were attended .

9- *Data analysis :*

Data were analysed using SPSS program. Qualitative significance testing (x2) was used.

10- *Ethical consideration :*

Consent from the hospital authority and from patients enrolled in the study was secured.

Chapter Three

Results

One hundred twenty patients who had been diagnosed as having nasolacrimal duct obstruction were included in this study and Ext-DCR surgery was done for each of them.

Study area: This study was done in the Department of Ophthalmology at AL-Thawra Hospital Sana'a City which is the capital of Yemen.

***Age distribution* :** Patients included in this study were between the age of 8 and 70 years , as shown in table (1) , with the mean age of 31.5 years .

Sex distribution : It showed that females patients were more than male patients where 86 patients (71.7%) of the studied group were females and 34 patients (28.3%) were males as shown in table (1) and figure (1) . The female to male ratio was (2.5 : 1) .

Symptoms : Present symptoms revealed that all the patients had a preoperative epiphora and in the past ocular history 62 cases (51.7%) had a history of repeated use of topical antibiotics while in the past medical history 5 (4.2%) patients had a history of facial trauma .

Signs: Ocular examination showed that all the patients had over flow of tears , 37 cases (30.8%) had fluctuant mass on the lacrimal sac area , 4 cases (3.3%) had fistula , regurgitation test

revealed that 70 cases (58.3%) had mucoid discharge and 50 cases (41.6%) had purulent discharge .

Slit lamp examination showed that the tear meniscus height was more than 2mm in all of the patients and 52 cases (43.3%) had concertions or pus from the punctum .

ENT examination revealed that 7 patients (5.8%) had nasal mucosal atrophy , 30 patients (25.0%) had sinusitis and 4 patients (3.3 %) had deviated nasal septum .

Lab findings: Culture for discharge expressed from the punctum showed that 26 (21 .7%) of the specimens were Staph , 20 (16.7%) were α Haemolytic *strept* and 9 (7.5%) were Candida *albicans* . All the patients who had infection (55 cases) received the suitable antibiotic according to the results of culture and sensitivity before the operation.

Indications : We divided the patients into groups according to the preoperative diagnosis . We found that the most common indication for Ext-DCR was chronic dacryocystitis which represented 67.5% (81cases) , then congenital NLD obstruction that represented 11.6% (14 cases) , followed by the primary acquired NLD obstruction which represented 10% (12 cases), 6.7% (8 cases) were those who underwent previous failed Ext-DCR and finally the last indication was those patients with previous facial trauma which represented 4.2% (5 cases). Table (2) shows the indications for Ext-DCR.

Intra-operative measures and findings: All the patients were prepared for surgery under general anaesthesia, so they underwent medical fitness.

Subcutaneous injection of adrenaline and xylocaine at the site of skin incision and nasal packing gauze saturated with adrenaline and xylocaine was done only for 17 cases (according to anaesthetist permission), while the rest of the patients didn't receive this subcutaneous injection and the nasal packing gauze was saturated with tetracycline ointment. Among those patients who received the subcutaneous injection and nasal packing with adrenaline and xylocaine, 14 cases (82.4%) didn't get an intra-operative bleeding and 3 (17.6%) of them developed mild intra-operative bleeding .

Skin incision was 11mm from the inner canthus and its size was 20 mm in all patients and the osteotomy size was equal to 1.5 x 1.5 cm in 116 cases, less than 1.5 x 1.5 cm in two cases and more than 1.5 x 1.5 cm in two cases.

Silicone tube insertion was routinely done in all of them while suturing of the anterior flaps were done for 114 cases (95.0%) and not done for 6 patients (5.0%) because the flaps were not available; (SR in patient with suturing of the anterior flaps was 98.3% and SR rate in those without suturing was 40.0%) . Suspensions of the flaps were done for those with

available flaps (114 cases) and not done for those with no available flaps (4 cases) .

Outcome: Our study showed that 111 (92.5%) patient from the 120 had complete resolution of all symptoms, but 9 cases (7.5%) had post operative primary epiphora, 4 of them were cases of chronic dacryocystitis, 2 were primary acquired NLD obstruction, 2 with trauma, and one was a case of congenital NLD obstruction. This primary epiphora resolved from 4 patients after probing and syringing but it didn't resolves from 5 patients (persistent epiphora). This was shown in table (5).

The SR according to the indications was as the following: The total SR was 96% as shown in table (3), the highest rate was among those patients with revision of previous failed DCR surgery and with those patients with primary acquired NLD obstruction where the SR was 100% in both of them, followed by chronic dacryocystitis where the SR was 97.5% , then congenital NLD obstruction where SR was 92.8% and lastly the trauma cases in which the SR was 60% . This was shown in table (4) .

The failed cases according to the indications as shown in table (5) and figure (6) were as the following: The failed cases were five (4%), two of them were cases of chronic dacryocystitis (1.6%) where one of them lost her silicone tube one month after surgery and didn't improve by syringing nor by

probing, two cases were trauma (1.6%) and one case was congenital NLD obstruction (0.8%) .

The details of failed cases were as follows: Three of them (10.0%) had preoperative sinusitis from which they are treated preoperatively , two had deviated septum , four of them had preoperative mucopurrulent discharge . Culture of that discharge showed that the causative organism was Staph in 3 cases and α Hemolytic *Strept* in one case. Non of them had been injected subcutaneously with xylocaine and adrenaline nor packed the nose with gauze saturated with adrenaline and xylocaine , so two of them had severe intra-operative bleeding, two developed moderate intra- operative bleeding and one had mild bleeding. Two of the failed cases had an osteotomy size of less than 1.5 x 1.5 cm where one of them was a case of trauma and the other one was a case of chronic dacryocystitis. About flaps, two of them had available sac and nasal mucosal flaps where the anterior flaps only were sutured and suspended while in the other three patients the flaps were not available. All failed cases had postoperative primary epiphora, two had wound infection , and one of them had skin scarring.

The complications as shown in table (6) were that, 52 cases (43%) had mild intra-operative bleeding (< 100 ml), 50 cases (41%) had moderate intra-operative bleeding (= 100 ml) and 4 cases (3%) had severe intra-operative bleeding (> 100 ml). Pain was experienced in 96 cases (80%) while 4 cases (3%)

had bruises. Seven patients (5.8%) had early postoperative bleeding in the form of epistaxis which stopped without the need for nasal packing.

Wound infection developed in 3 cases (2.5%) while skin scarring developed in 3 cases (2.5%) also and one patient had punctal tear. Primary epiphora occurred in 9 cases (7.5%) while 5 cases had persistent epiphora.

Table 1 : Shows the percentage of age & gender distribution of patients subjected for Ext- DCR

Age group (years)		Sex		Total
		Male	Female	
8-17	Count	8	18	26
	Percent	6.7%	15%	21.7%
18-27	Count	9	12	21
	Percent	7.5%	10%	17.5%
28-37	Count	7	22	29
	Percent	5.8%	18.3%	24.2%
38-47	Count	3	25	28
	Percent	2.5%	20.8%	23.3%
48-57	Count	4	7	11
	Percent	3.3%	5.80%	9.2%
58-70	Count	4	1	5
	Percent	3.3%	0.8%	4.2%
Total	Count	34	86	120
	Percent	28.3%	71.7%	100%

Table 2: Shows the indications for Ext-DCR

Indications	No. of patients	Percentage
Chronic dacryocystitis	81	67.5%
Congenital N. L.D obstruction	14	11.6%
1ry acquired N. L.D obstruction	12	10%
Previous failure DCR	8	6.7%
Trauma	5	4.2%
Total	120	100%

Table 3:Shows the number of successed and failed cases of Ext-DCR and their Percentages

	No. of patients	**Percentage**
Successed cases	115	96%
Failed cases	5	4%
Total	120	100%

Table 4 : Shows the Success rates of Ext-DCR operations according to indications

Indications	No. of patients	Percentage from the total (%)	Failed cases (NO)	Success cases (NO)	Success Rate (%)
Chronic dacryocystitis	81	67.5%	2	79	97.5%
Congenital N. L.D obstruction	14	11.6%	1	13	92.8%
1ry acquired N. L.D obstruction	12	10%	0	12	100%
Previous failure DCR	8	6.7%	0	8	100%
Trauma	5	4.2%	2	3	60%
Total	120	100%	5	115	96%

Table 5 : Shows the failed cases of Ext-DCR according to indications and their Percentages

Indications	**Primary epiphora (NO)**	**Persistent epiphora (failed cases)**	**Percentage of (failed cases) (%)**
Chronic dacryocystitis	4	2	1.6%
Congenital N. L.D obstruction	1	1	0.8%
1ry acquired N. L.D obstruction	2	0	0
Previous failure DCR	0	0	0
Trauma	2	2	1.6%
Total	9	5	4%

Table 6 : Shows the complications of Ext-DCR operations and their percentage

Complication	Number of patients	Percentage from the total (%)
Mild intra-operative bleeding (< 100ml)	52	43%
Moderate intra-operative bleeding (= 100ml)	50	41.6%
Severe intra-operative bleeding (>100ml)	4	3%
Pain	96	80%
Brusis	4	3%
Post- operative bleeding (second day after surgery)	7	5.8%
Wound infection	3	2.5%
Skin scarring	3	2.5%
Primary epiphora	9	7.5%
Persistent epiphora	5	4%
Punctal tear	1	0.8%

Figure 1: Shows the Percentage of gender distribution of patients subjected for Ext-DCR

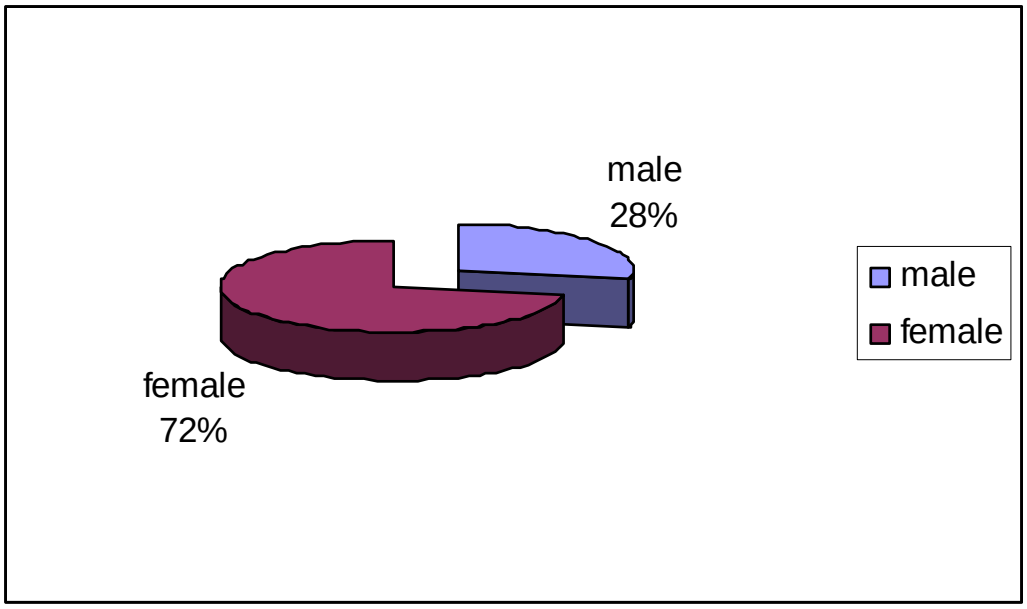


Figure 2: Shows Percentage of age distribution of patients subjected for Ext-DCR

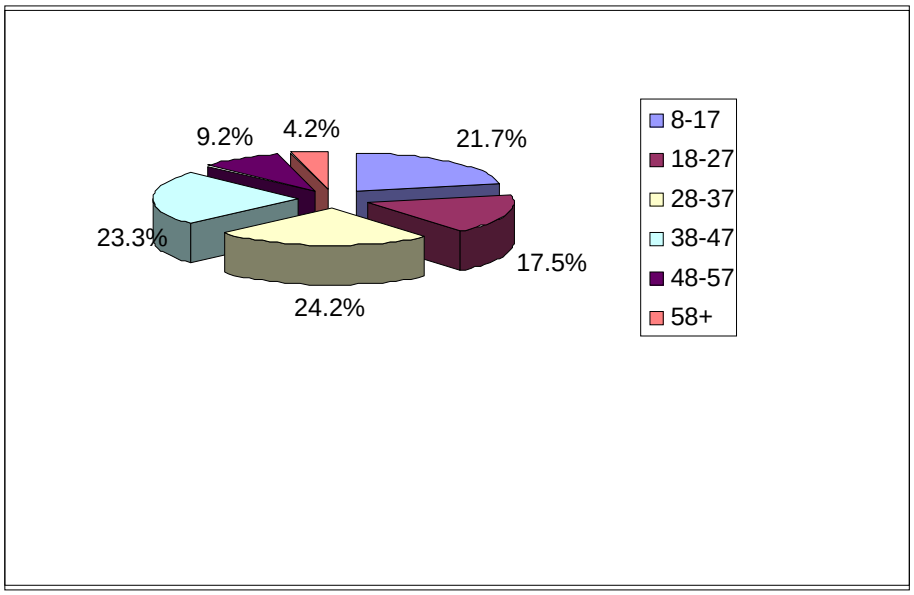


Figure 3: Shows the number of successed and failed cases of Ext- DCR

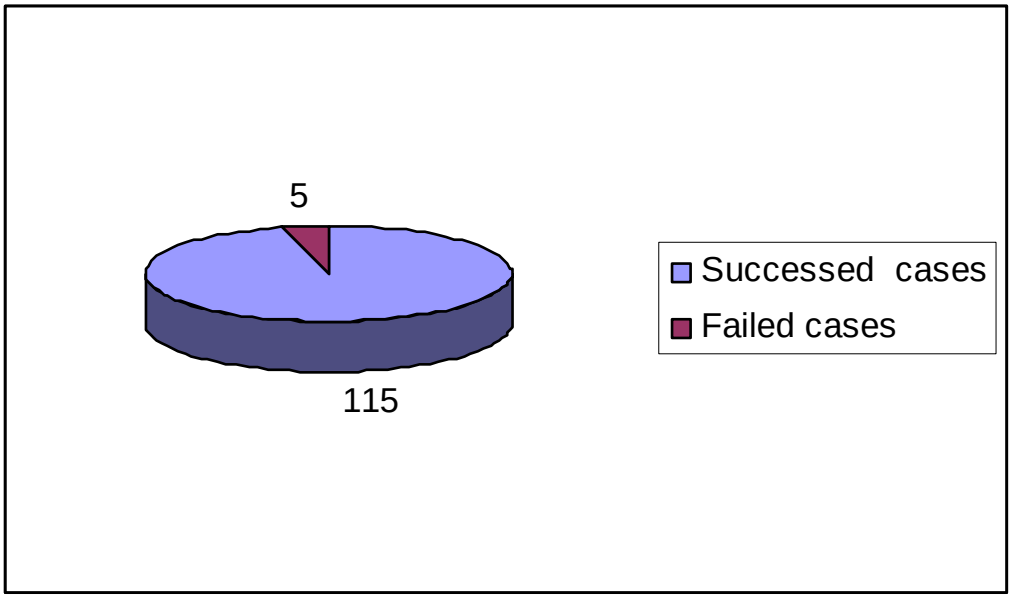


Figure 4: Shows the number of patients under went Ext-DCR operations according to indications

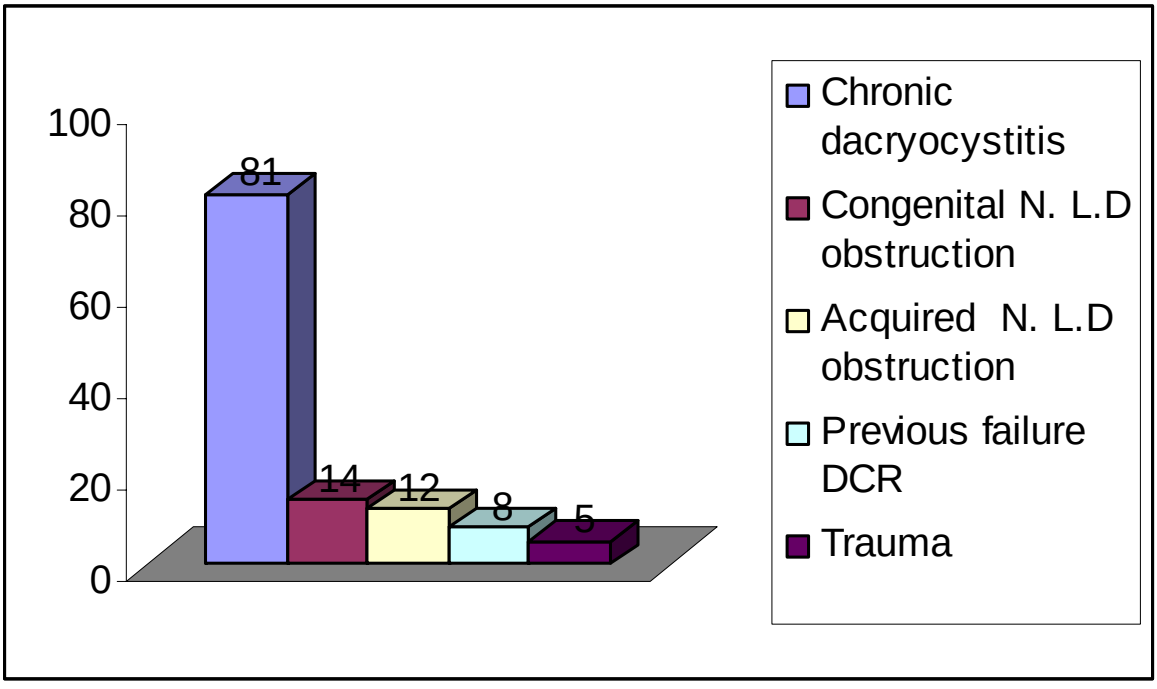


Figure 5: Shows the indications for Ext-DCR

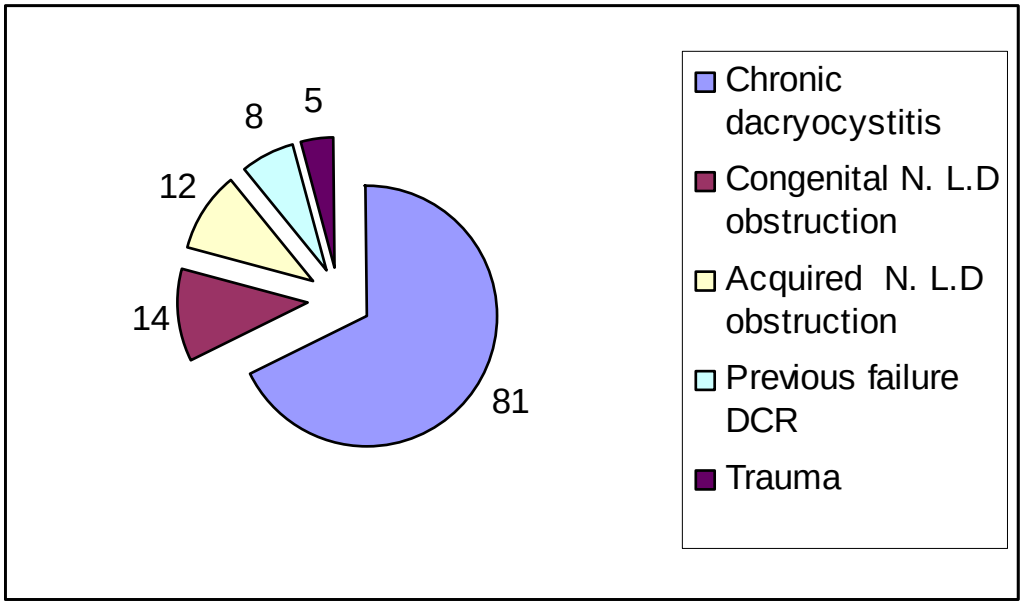


Figure 6: Shows the failed cases of Ext-DCR according to indications

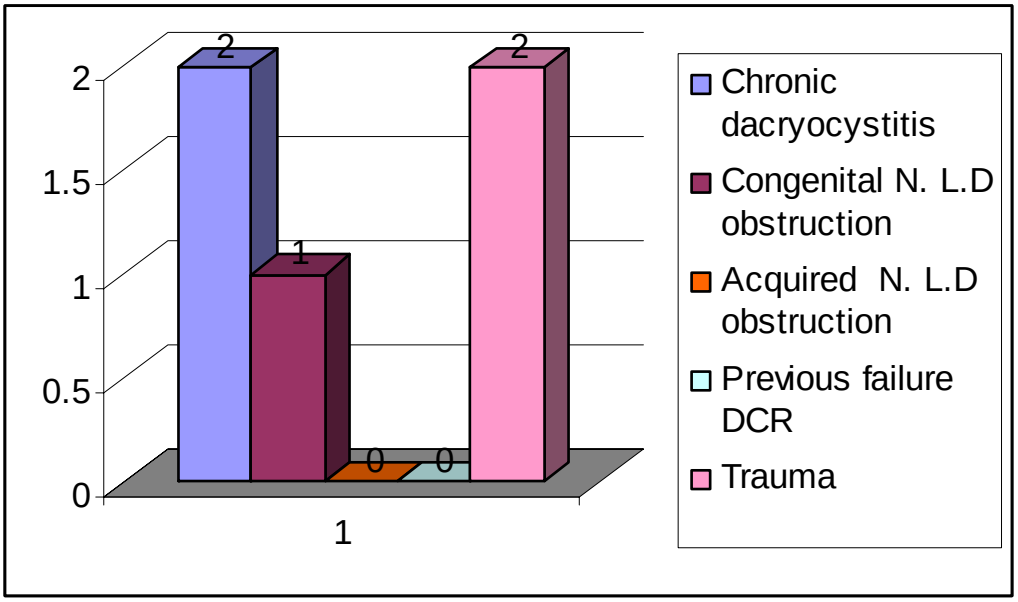
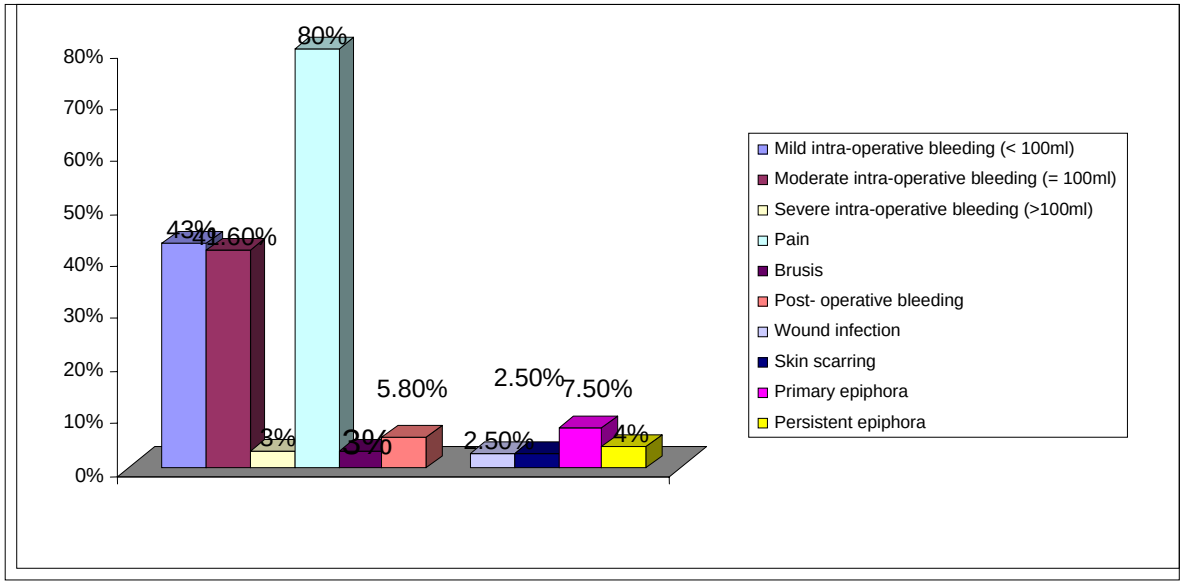


Figure 7 : Shows the complications of Ext-DCR operations and their percentage



Chapter four

DISCUSSION

External DCR is one of the most popular and acceptable procedures practiced for relief of obstructive epiphora due to blockage in the distal part of the nasolacrimal apparatus. Various other techniques like Ext-DCR with intubation, endoscopic dacryocystorhinostomy[185], endoscopic laser assisted nasal dacryocystorhinostomy[186], and dacryocystoplasty, have been used.[187]

In our study we performed the Ext-DCR with techniques of Dutemps and Bourguet[5] in which only the anterior flaps are sutured and suspended. Silicone intubation was done for all the patients .

A total of 120 cases were recruited for the study underwent for Ext-DCR under general anaesthesia with routine use of silicone tube, which is a useful adjunct to Ext-DCR procedure and was advocated by Older[15] . Females were predominant in this study where female to male ratio was 2.5 : 1, while female to male ratio in two Pakistani studies were 2: 1[12,188], but in the American study the female predominance is more distinct with a 3 : 1 ratio[189] . Patients ages in our study ranged from 8 years up to 70 years , with a mean age of 31.5 years, this is not going with a study done in Pakistan that showed a mean age of 41.5 years ,with age ranged from 3 to 83 years[188]. Another study done in Spain showed that the patients ages ranged from 19 years to 88 years with a mean age of 48years[190], while an American study showed a mean age of 57 years, with age ranged from 48 to 76 years [189].

In our study 42% of the patients were between 18-37 years (young adults), while 32.5% of them were between 38 – 57 years, followed by the paediatric age group 8 – 17 years which accounts 21.7 % and the elder age group came lastly 58 – 70 years which account only 4.2% of the whole patients.

About the indications for Ext-DCR, in our study according to our preoperative diagnosis we found that the most common indication was chronic dacryocystitis which represented 67.5% (81cases) followed by congenital NLD obstruction that represented 11.6% (14 cases) then the primary acquired NLD obstruction which was 10% (12 cases), next to it was the previous failure DCR which represented 6.7% (8 cases)and lastly trauma which was represented 4.2% (5 cases).

Study done in Spain showed that the indication for Ext-DCR was primary acquired NLD in 59.5% and chronic dacryocystitis in 40.4%[190].

In our study 54 (45.0%) of the patients had purulent discharge from their puncti , so we did culture for that discharge and we found that the causative organisms were Staphylococcus in 25 cases (21%), α haemolytic Streptococcus in 20cases (16.7%) and Candida albicans in 9 cases (7.5%) , while

a microbiological study done in UK showed 78.5% of the growth were gram-positive bacteria , and 76.5% of them were Staphylococcus species[89]. Another study in Japan reported that a series of 4 cases of dacryocystitis with culture positive for methicillin resistant Staphylococcus *aurius* , which is regarded as one of the most difficult organisms to be treated , which showed

dramatic response after Ext-DCR with complete resolution of all symptoms[90].

Our final success rate was 96% (115 patients) while the initial success rate was 92.5% with primary epiphora in 7.5% of cases , for whom probing and irrigation were done with resultant disappearance of epiphora in 2.5% . The result of our study can be compared with studies done in other places such as that which was done in Egypt which showed that a SR of 90%[191], another study done in Pakistan in 2003 that showed a SR of 89% while the other one done also in Pakistan in 2005 showed a success rate of 97.5% [12,188], this improvement in the results may be related to progress in the surgical technique by stitching the mucosal bridge With the muscle layer and may also be due to instrumental improvement[12] . In Italy a SR was 100% [18] , while in USA their SR was 95% in one study[192] ,96% in a second one[193] ,and 96.5% in a third one[194].

In UK a study showed a SR of 94%[195] , While another study showed an overall SR of 83.5% (it was 98% if we exclude results of upper obstruction)[196] , but from Oxford , the SR was 90% [197].

In Canada a retrospective study done in 2003 SR was 95%[198]. Another retrospective study at Munster University , in Germany was done to assess the Ext-DCR on 296 children with age up to 3 years , with a SR of 78.9%[199] , and finally a study report from Finland the SR was 91% [200].

The success rate according to the diagnosis in our study was as the following : The SR was the highest among those patients who underwent Ext-DCR after previous failed DCR done for them before, where SR in this group was 100%(not statistically significant

p= .542) , that is also supported by an American report that the revision should only be done by an Ext-DCR[201], also the SR of primary acquired NLD obstruction was 100% , followed by chronic dacryocystitis with a SR of 97.5% (statistically not significant p=0.169) , then congenital NLD obstruction with a SR of 92.8% and lastly trauma with a SR of 60%(statistically significant p=0.001) . Study done in Pakistan showed that a SR according to the diagnosis was as the following: 92% of SR was among those with primary acquired NLD obstruction, followed by those with a previous surgery where the SR was 90%, then the congenital NLD with a SR of 72% and finally the trauma group where the SR was 71%[188]. Another study done in United Kingdom in 1998, where the success rate according to the diagnosis was 98% in chronic dacryocystitis and 95% in NLD obstruction[202]. There are many factors that affect the success rate of Ext-DCR such as the surgeon's experience[7,104],intra operative application of mitomycin C[172,173,203] (not used in this study as it is not a valiable in that hospital) ,and the site of obstruction[159]. Our study showed that suturing of the anterior flaps (nasal and lacrimal) improve the outcome of the surgery where the SR was 98.3% in those patients with suturing of the anterior flaps and 40.0% in those without suturing , the difference in the SR between the two groups was statically significant (p=0.000) . Suspension of the flaps showed no difference in the SR between those patients with or without suspension of the anterior flaps where p=.116 (statistically not significant).

The success rate also depending on the presence of preoperative risk factors such as intra-nasal pathology, nasal scarring and intra-

operative risk factors consisted of technical difficulties such as deviated nasal septum, anteropositional anterior ethmoidal air cells and intra-operative bleeding[9]. However another study indicated that the functional outcome of DCR was related to the size of the rhinostomy after surgery which is markedly reduced[178], the osteotomy size was statistically significant in relation to the SR in our study where p=0.000 . and another one said that the outcome was related to the eye lid condition[179].

However the previous factors that affect on the SR of Ext-DCR are going to some extent with what we found in our study. . Our failed cases were five, two of them had deviated septum (statistically not significant p=.320), two had severe intra-operative bleeding, two had moderate bleeding and one had mild intra-operative bleeding . The osteotomy size in two of failed cases was less than 1.5 x 1.5 cm and both of them had deviated septum which leads to technical difficulties , this is going to some extent with what they found in the previous studies . Review of complications recorded in our study were that the intra-operative bleeding where 43% (52 cases) of the patients had mild intra-operative haemorrhage of less than 100ml, 41.6% (50 cases) had moderate bleeding about 100ml and only 3% (4 cases) of the patients had severe haemorrhage of more than 100 ml. Seven of the patients (5.8%) experienced a postoperative bleeding (second day after operation) in the form of epistaxis which stopped without the need for nasal repacking.The difference in the development of intra-operative between the patients who received adrenaline with xylocaine and who didn't receive was statistically significant (p=0.000). The SR in patients who had intra-operative

bleeding and those who had no intra-operative bleeding was statistically not significant (p=.406). Three cases (2.5%) had wound infection which was statistically significant p=.000 , three of them (2.5%) had skin scarring at the site of skin incision and one patient (0.8%) had punctal tearing.

The complications recorded in our study can be compared with a retrospective study done in Canada in 2003 with the complications reported as the following: 4.6% had epistaxis, 2.6% had lid eversion (due to skin scar contraction)[196].

In France, they reported only 2 cases of postoperative lagophthalmus after Ext-DCR, which resolved spontaneously within 3 months[204].

In USA, they did a retrospective study on 169 Ext-DCR surgery with the following reported complications: haemorrhage (3.9%) , scarring (2.6%) and 97% of the patients rated their incision as good to excellent in appearance and all patients stated that, they would recommend the procedure for others [202].

CONCLUSION

- External DCR combined with silicone intubation showed a high success rate in AL-Thowra Teaching Hospital which represents Yemeni patients as it is the main referral hospital in the country.
- Female to male ratio was 2.5: 1 among those patients subjected for Ext-DCR.
- The age of the patients was between 8 and 70 years with the mean age of 31.5 years.
- Chronic dacryocystitis was the main indication for Ext-DCR.
- Failure rate was high among those patients with trauma while the success rate was high among those patients with of previous failed DCR by external approach and those patients with primary acquired N.L.D obstruction.
- The success rate in our study depends on the presence of pre-operative risk factors such nasal scarring and deviated nasal septum which led to technical difficulties during operation .
- The functional outcome of Ext-DCR was related to the size of osteotomy done during the surgery as there were

two failed cases in which the size of osteotomy done for them was less than 1.5 x 1.5 cm .

- Those patients who received a Subcutaneous injection of adrenaline with xylocaine and nasal packing with gauze saturated with adrenaline and xylocaine did not get an intra-operative bleeding and post-operative epistaxis, which give clear area to work during the operation and help in the creation of the osteotomy and mucosal flaps during the operation .
- External DCR had complications in the form of controllable intra-operative bleeding, wound infection, skin scarring and punctal tear which they were not frequent.

RECOMMENDATIONS

- There is no data about the patients preoperatively, diagnosis , intra-operatively , and postoperatively in the filing system of the hospital . There is also no information about the results of the operations which is important to compare our study results with the actual situation of the Ext-DCR in Yemen before , so the filling system of the hospital should be improved.

- Every ophthalmologist should be encouraged to train and do Ext-DCR as it is a beneficial surgery with high success rate but it needs some experience which can be acquired by continuous education, learning from those surgeon's who had experience in this type of surgery on practicing .

- In our study patients who received adrenaline with xylocaine at the site of skin incision and with the nasal packing gauze didn't get an intra-operative bleeding , so the area of the operation in those was clear and the work in that clear area was easier than those with bloody area in dissection , controlling the osteotomy size , intubation and stitch which in turn improve the outcome of the surgery , for that reason this step in the Ext-DCR surgery should be done if there is no any medical contra-indications for that in order to reduce the amount of intra-operative bleeding which was significantly high in our study .

- There was a strong relation between the osteotomy size and the result of the operation as the size of osteotomy was less than 1.5 x 1.5 cm in two of failed cases , so the osteotomy size done intra-operatively shouldn't be less than 1.5 x 1.5 cm .

-Suturing of the anterior flaps of the sac and nasal mucosa showed improvement in the outcome in our study, for that reason it is an important step in this surgery and should be done for every patient who underwent to do this surgery .

- Proper counseling of patients postoperatively in how to care about his or her silicone tube and how long it should remains before its removal . The post-operative care should be done by a well trained person .

- ENT examination for the patients should be done when needed for those with an intra-nasal pathology which can lead to difficulties during surgery .

- Measurement of IOP and assessing the angle of the anterior chamber should be done in those who are going to receive adrenaline with xylocaine subcutaneously and with the nasal packing gauze as the use of these medications can lead to acute angle closure glaucoma. Also intravenous atropine which is sometimes used during general anaesthesia is a mydriatic and can lead to an acute angle closure glaucoma .

- The excised posterior flap of the lacrimal sac which was done during the operation should be send for histopathological examination (which is not done in the hospital) .

- We recommend another study to evaluate the impact of the tube on the outcome of the surgery in order to know the proper duration for intubation .

-Ext-DCR has a high success rate among Yemeni patients like other patients world wide, but there are other modifications done in places outside Yemen in order to improve the outcome of Ext-DCR . Because of non availability of these modifications in Yemen , they were not done in this work but it is highly recommended that they should be introduced to that hospital in Yemen , these are the following :

a- Mitomycin C application in dacryocystorhinostomy is effective in increasing the success rate of Ext-DCR surgery especially in those patients with relatively high failure rate such as patients with trauma .

b- Nasal endoscopy should be introduced to the Ophthalmic Department of the hospital which helps in preoperative diagnosis of the level of obstruction, postoperative assessment of soft tissue anastomosis, nasolacrimal ostium and for removal of lacrimal stents which should be routinely done under direct visualization with the nasal endoscope to reduce nasal mucosal trauma that may be acquired during blind retrival of these tubes and also to eliminate the possibility of tubes lost after being cut at the medial canthus.

c- Dacryocystography should be emphasised as a diagnostic tool used preoperatively to detect the presence of scarring which indicates a far worse prognosis, also B mode ultrasonography should be available in ophthalmic department that may provide sufficient functional and anatomical information in the

outpatient setting to obviate the need for dacryocystography or nasal endoscopy .

d- Endonasal laser dacryocystorhinostomy should be introduced to the Ophthalmic Department at Al-Thawra Hospital for those patients who have liability for blood loss during the operation or who are medically unfit for operation under general anaesthesia and for elderly patient as it has a short operative time and can be easily performed under local anaesthesia, also the Holmium: YAG laser allows haemostasis.

REFERENCES

1- Kikkawa DO, Heinz GW, Martin RT, etal: Orbital cellulitis and abscess secondary to Dacryocystitis. Arch Ophthalmol 2002; 120(8):1096-1099.

2- Yazici B and Yazici Z : Final Nasolacrimal Ostium After External Dacryocystorhinostomy . Arch Ophthalmol 2003; 121(1) : 76-80 .

3- Shin S and Thuraira JA : External dacryocystorhinostomy-an end of an era? Br J Ophthalmol 1997; 18: 716-17.

4- Stewart WB: Ophthalmic plastic & Reconstructive Surgery , Academy manual program. California: American Academy of Ophthalmolgy, 1984:455-471.

5- Dupuy-Dutemps L, Bourguet J: Procede plastique dacryocystorhinostomie et ses resultants. Ann Ocul J 1921; 158,: 241-61 .

6- Wobig JL , Dailey RA : Surgery of the lacrimal apparatus. Ophthalmic Surgery . St Louis , CV Mosby , 1993 .

7- Speath GL .Ophthalmic surgery ; Principles and Practice 3rd ed Vol 2 USA Elsevier science 2003 : 509-25 .

8- Tsirbs A, Wormald PJ: Mechanical endonasal dacryocystorhinostomy with mucosal flaps . Br J Ophthalmol 2003; 87: 43-7 .

9- Sadiq SA , Ohrlich S , Jones NS , Downes RN : Endonasal laser dacryocystorhinostomy-medium term results . Br J Ophthalmol 1997 ; 81:1089-92 .

10- Becker BB : Dacryocystorhinostomy without flaps . Ophthalmic Surg 1988; 19: 417-27 .

11- Hofmann T , Lackner A, Muellner K, Luxenberger W, Wolf G: Endolacrimal KTP laser-assisted dacryocystorhinostomy. Arch Otolaryngol Head Neck Surg 2003 ; 129 :329-332 .

12- Zaman M, Babar TF , Abdullah A : Prospective Randomized Comparison of Dacryocystorhinostomy (DCR) with and without intubation . Pakistan J Med Res 2005 ; 44(2) : 75-78.

13- ILIFF CE : A simplified dacryocystorhinostomy 1954-1970 ; Arch Ophthalmol 1971 ; 85: 586 -91 .

14- Tse DT : Colour Atlas of Ophthalmic Surgery , Oculoplastic Surgery . Philadilphia : Lippincott company , 1992:75-100 .

15- Older JJ: Routine use of silicone stent in a dacryocystorhinostomy . Ophthalmic Surg 1982; 13:911-5.

16- James A , Katowit Z , Joanne EL : Lacrimal drainage Surgery; Duane,s ophthalmology. CD-ROM edition. Philadilphia; Lippincott Williams &Wilkins publishers , inc, 2004 .

17- Sweet RM, Hfman RF: Surgical considerations for dacryocystorhinostomy with special emphasis on haemostatic technique . Ophthalmic Surg , 1983; 14:317-321 .

18- Baldeschi L , Nardi M, Hintschich CR , Koornneef L : Anterior suspended flap : A modified approach for External DCR . Br J Ophthalmol 1998 ; 82:790-792 .

19- Allen KM, Berlin AJ : Dacryocystorhinostomy failure: association with nasolacrimal silicone intubation. Ophthalmic Surg 1989; 20: 486-489 .

20- Sperkelsen MB, Barberan MT: Endoscopic dacryocystorhinostomy – Surgical technique and results . Laryngoscope 1996 ; 20: 486-489 .

21- Weidenbecher M, Hosemann W , Buhr W : Endoscopic endonasal dacryocystorhinostomy , results in 56 patients . Ann Otol Rhinol Laryngol 1994 ; 103:363-367 .

22- Jokinen K, Karja J : Endonasal dacryocystorhinostomy . Arch Otolaryngol 1974 ; 100 : 41-44 .

23- Massaro BM , Gonnering RS, Harris GJ : Endonasal laser dacryocystorhinostomy. A new approach to nasolacrimal duct obstruction. Arch Ophthalmol 1990 ; 108:1172-1176 .

24- Camara JG , Benzgon AU , Henson RD : The safety and efficacy of mitomycin C in endonasal endoscopic laser-assisted dacryocystorhinostomy. Ophthalmic Plast Reconstr Surg 2000: 16 -114 -118 .

25- Szubin L , Papageorge A , Sacks E : Endonasal laser-assisted dacryocystorhinostomy . Am J Rhinol 1999 ; 13: 371-374 .

26- Khurana AK , Khurana I : Anatomy and physiology of eye 2nd ed India Binding house 2005 ; 10:337-63 .

27- Bron AJ, Tribath BJ : Wolff,s Anatomy of the eye and orbit , 8th ed Philadelphia : Lippincott-Raven; 1998 .

28- Shun-Shin GA , Geetha T : External DCR-an end of an era ? . B J Ophthalmol 1997 , 81:716-717 .

30- Collin R, Rose G: Plastic and orbital surgery. 1sted . London: BMJ Books 2001 , 98 : 161-168 .

31- Camara JG , Benzgon AU : Nasolacrimal duct obstruction (2005) <htt://www.emedicine.com/oph/topic465.htm>accessed on 3/8/2005.

32- Lemp MA , Wolfly DE : The lacrimal apparatus . In Hart WM Jr , editor : Adler,s physiology of the eye , edg, st Louis , 1992, Mosby.

33- Remington LA :Clinical anatomy of the visual system , 2nd ed , Elsevier science , st Louis 2005, 9 : 137 -147 .

34- Lemke BN : Lacrimal anatomy , Adv Ophthal Plast Reconstr Surg 1984, 3:11 .

35- Kanski JJ . Clinical Ophthalmology : A systemic approach . 5th ed . Oxford : Butterworth – Heinemann , 2005 : 51. 109 .

36- Austen DP: Lacrimal Dilation & Syring. (2008)

<http:/www.academy.org.uk/tutoryials/dilation.htm > accessed on 20/1/2008.

37- Doane MG : Blinking and mechanics of the lacrimal drainage system, Ophthalmology 1981, 88(8) : 844 .

38- Wobig JL: The lacrimal apparatus. Ophthalmic anatomy, F.San Francisco . American Academy of Ophthalmology 1981 : 55 .

39- Petersen RA , Robb RM : The natural course of congenital obstruction of the nasolacrimal duct, J pediatr Ophthalmol Strabismus 1978,15: 246 .

40- Mann I : The development of human eye . Br J Ophthalmol, 1979: 260.

41- Duke-Elders: Text book of Ophthalmology. Vol 5. St Louis : CV Mosby, 1992 : 5348-5358 .

42- Masi AV : Congenital fistula of the lacrimal sac , Arch Ophthalmol 1969 , 81: 701 .

43- Selvel D: Developmental and congenital abnormalities of the nasolacrimal apparatus, J Pediatr Ophthalmol Strabismus 1981, 18:13.

44- Kaufman PL, Alm A : Anatomy and function of the lacrimal excretory system . Adler,s physiology of the eye , 10th ed . St Louis: CV Mosby 2003, 3: 40-43 .

45- Vanden WA , Leenders I,Mulder :Topographic anatomy of the eye lids, and the effects of sex and age . Br J Ophthalmol 1999,83: 347.

46- Lin PY , Tsai SY , Cheng CY, etal : Prevalence of dry eye among an elderly Chinese population in Taiwan. Ophthalmology 2003, 110(6):1096.

47- Schaumberg DA, Sullivan DA, Buring JE, etal: Prevalence of dry eye syndrome among US women. Am J Ophthalmol 2003, 136(2):318.

48- Mishima S : Some Physiologic Aspects of precorneal tear film . Arch Ophthalmol 1965 , 73 :233 .

49- Chavis RM, Maisey MN, Whelham RA: Quantitive lacrimal Scintillography . Arch Ophthalmol 1978, 96:2066 .

50- Sisler HA : Current concepts in the understanding of lacrimal drainage. Adv Ophthalmic Plast Reconstr Surg 1984 , 3:25 .

51- Thale A etal : Functional anatomy of the human efferent tear ducts : a new theory of tear and follow mechanism , Gracfe,s Arch clin exp Ophthalmol 1998 , 236 : 674 .

52- White WL, Clover AT , Buckner AB, etal :Relative canalicular tear flow as assessed by dacryoscintigraphy. Ophthalmology 1989, 96: 167.

53- Meyer D, Antonello A, Linberg J : Assessment of tear drainage after canalicular obstruction using fluorescein dye disappearance. Ophthalmol 1990 , 97: 370 .

54- Lyons CJ, Rosser PM, Welham RA: The management of punctal agenesis. Ophthalmology 1993, 100(12) : 1851-5 .

55- Chronister CL , Lee A, Kaiser H : Rarely reported of congenital atresia of nasolacrimal puncta . Optometry 2002, 73(4) :237-42 .

56- Bashour M : Nasolacrimal Duct , Congenital Anomalies (2007) <http://www.emedicine.com/oph/topics592.htm>accessed on 12/10/2007.

57- Levitt JM, Kravitz D: Lacrimal anomalies. Arch Ophthalmol, 1959: 61:9.

58- Paul TO, Shepherd R: Congenital nasolacrimal duct obstruction: natural history and the timing of optimal intervention . J Pediatr Ophthalmol Strabismus. 1994, 31(6) : 362-7 .

59- Gassady JV: Developmental anatomy of nasolacrimal duct, AMA Arch Ophthalmol 1952 , 47(2) : 141-58 .

60- Tear duct obstruction (2005)<http://www.pedseye .com/NIDO.htm> Accessed on 3/8/2005 .

61- Khaw PT, shah P, Elkington AR: ABC of Eyes, 4th ed, BMJ Books.

62- Young JD, MacEwen CJ: Managing congenital lacrimal obstruction in general practice . BMJ. 1997, 315(7103): 293-6 .

63- Jones LT, Wobig JL : Newer concepts of tear duct and eyelid anatomy and treatment. Trans Am Acad Ophthalmol Otolaryngol, 1977: 82-603.

64- Tardiff A, Cole III HP, Wesley RE and Jeanty P: Dacryocystocele (2007)<http://www.the fetus .net/page.php>accessed on 7/11/2007.

65- Davis WK , Mabony BS , Carroll BA , etal : Antenatal sonographic detection of benign dacryocystoceles (lacrimal duct cysts). J Ultrasound Med 1987 , 6 : 461-465 .

66- Rand PK, Ball Jr WS, Kulwin WR: Congenital nasolacrimal mucoceles: CT evaluation. Radiology 1989 , 173 : 691-694 .

67- John PR, Boldt D: Bilateral congenital lacrimal sac mucoceles with nasal extension . Pediatr Radiol 1990 , 20 : 285-286 .

68- Cibis GW,Spurney RO, Waeltermann J:Radiographic visualization of congenital lacrimal sac mucoceles . Ann Ophthalmol 1978, 18:68 -69 .

69- Viers ER : Lacrimal disorders . Diagnosis and Treatment . St.Louis , CV Mosby co., 1976 , 37- 46 .

70- Weinstein GS, Biglan AW, Patterson JH: Congenital lacrimal sac mucoceles . Am J Ophthalmol 1982, 94 : 106-110 .

71- Kim BJ, Tsirbas A , Franz CO : Epiphora caused by upper lacrimal Drainage system problems . Compr Ophthalmol update 2005 ; 6(5): 231-236 .

72- Meller D , Tseng SC : Conjunctivochalasis : Literature review and possible pathophysiology . Surv Ophthalmol 1988 , 43:225-32 .

73- Chronic Epiphora (2008)<http://www.revoptom.com/hand book/ sectli.htm>accessed on 19/1/2008 .

74- Kashkouli MB , Beigi B, Murthy R, etal : Acquired external punctal stenosis : etiology and associated findings . Am J Ophthalmol 2003 , 136:1079-84 .

75- Graff JM , Johnson AT : Punctal and canalicular stenosis (dacryostenosis) from Docetaxel : 38 years old female with persisting tearing for 6 months EyeRounds .Org . February 21 , 2005[cited-today, sdate-]; Available from: http://webeye.ophth.uiowa .edu/eyeforum/cases 31 .htm .

76- Esmaeli B , Valero V , Ahmadi MA , Booser D : Canalicular stenosis secondary to docetaxel (taxotere) : a newly recognized side effect . Ophthalmology 2001 ,108(5): 994-5 .

77- Esmaeli B , Ahmadi MA , Rivera E , Valero V etal : Docetaxel secretion in tears : association with lacrimal drainage obstruction . Arch Ophthalmol 2002 , 120(9) : 1180-2 .

78- Cleveland MG , Ajaikumar BS , Reqanti R : cutaneous fibrosis induced by docetaxel : a case report . Cancer 2000, 88(5):1078-81.

79- Camara JG , Bengzon Au : Nasolacrimal duct obstruction (2006) . <htt://www.emedicine. com/oph/topic 465.htm> accessed on 9/5/2006.

80- Burns JA, Morgenstem KE, Cahill KV , Foster JA , etal : Nasolacrimal obstruction secondary to I(131) therapy . Ophthal Plast Reconstr Surg . 2004 , 20(2) : 126-9 .

81- Call NB , Welham RAN : Epiphora after irradiation of medial eye lid tumors . Am J Ophthalmol 1981 , 92:842 .

82- Mawn LA : Laceration , canalicular (2006).<htt://www.emedicine. com/oph/by name/ laceration-canalicular. htm> accessed on 14/2/2008.

83- Harley RD , Stefanyszyn MA , Apt L etal : Herpetic canalicular obstruction . Ophthalmic surg 1987 , 18 :367 .

84- Wojno TH: Allergic lacrimal obstruction. Am J Ophthalmol 1988, 106: 48 .

85- Kanski JJ : Disorders of the lacrimal drainage system . Clinical Ophthalmology; 4th ed. Oxfored:Butterworth-Heinemann 1999,2:52-54.

86- Valenzuela AA , McNab AA , Selva DS , etal : Clinical features and management of tumors affecting the lacrimal drainage apparatus. Ophthalmic Plast Reconstr surg . 2006 ; 22:96-101 .

87- Kohn R , Nofsinger K , Freedman SI : Rapid recurrence of papillary squamous cell carcinoma of the canaliculus . Am J Ophthalmol 1981,92(3):363-7 .

88- McEwen, Donna R: Surgical treatment of dacryocystitis . AORN J 1997, 66:268-280 .

89- DeAngelies D, Hurwitz J , Mazzulli T : The role of bacteriologic infection in Aetiology of NLD obstruction . Can-J-Ophthalmol 2001 , 36(3): 134-9.

90- Kubo M , Sakuraba T , Arai J , Nakazawa M :DCR for dacryocystitis caused by methicillin-resistant staphylococcus aureus, report of four cases. Jpn-J-Ophthalmol 2002 , 46(2):177-82 .

91- Harris GJ , Williams GA, Clarke GP : Sarcoidosis of the lacrimal sac . Arch Ophthalmol , 1981:99-1198 .

92- Carlin R , Henderson JW : Malignant lymphoma of the lacrimal sac . Am J Ophthalmol 1994 , 15; 118(5): 650-8 .

93- Jordan JR , Nerad JA : Diffuse large-cell lymphoma of the nasolacrimal sac . Can J Ophthalmol . 1988 , 23:34-37 .

94- Bartley GB : Acquired lacrimal drainage obstruction : an etiologic

classification system , case reports , and a review of the literature . part 1. Ophthal Plast Reconstr Surg 1992 ; 8(4) : 237 – 42 .

95- Kheterpal S, Chan SY, Batch A , Kairkby GR : Previously undiagnosed lymphoma presenting as recurrent dacryocystitis . Arch Ophthalmol 1994 , 112:519-520 .

96- Saccogna PW, Strauss M , Bardenstein DS : Lymphoma of the nasolacrimal drainage system . Otolaryngol Head Neck Surg 1994 , 111:647-651 .

97- Erickson BA , Massaro BM , Mark LP , Harris GJ : Lacrimal collecting system lymphomas : integration of magnetic resonance imaging and therapeutic irradiation. Int J Radiat Oncol Biol Phys. 1994, 29: 1095-1103.

98- Pe,er JJ , Stefanyszyn M , Hidayat AA : Nonepithelial tumors of the lacrimal sac . Am J Ophthalmol 1994 , 118:650-658 .

99- Nakamaura K, Uchara S, Omigari J, etal : Primary non—Hodgkin's lymphoma of the lacrimal sac. Cancer 1997 , 80 : 2151- 2155.

100- el-Hakim H , Nunez DA : Non-Hodgkin's lymphoma of the lacrimal sac and concomitant pan sinusitis. J Laryngol Otol. 1998;112 :969–970.

101- Mari T , Tokuhira M , Morei S , etal : Primary natural killer cell lymphoma of the lacrimal sac . Ann Hematol 2001 ; 80 : 607 – 610 .

102- Schefler AC , Shields CL , Shields JA , etal : Lacrimal sac lymphoma in a child . Arch Ophthalmol 2003 , 121(9) : 1330 – 1333 .

103- Stefnescu-Dima A , Petria I , Croui S : Carcinoma of the lacrimal sac . Revchir Oncol Radiol ORL oftalmol Ser Oftalmol 1989; 33(3): 231-4.

104- Linberg JV , McCormick SA : Primary acquired nasolacrimal duct obstruction : A clinicopathologic report and biopsy technique.

Ophthalmology , 1986 : 93(8):1055-63 .

105- Bajaj MS , Nainiwal SK , Pushker N , Sen S : Neurofibroma of the lacrimal sac . Orbit 2002 , 21(3) : 205 – 8 .

106- Bernardini FP, Moin M, Kersten RC, Etal: Routine histopathologic evaluation of the lacrimal sac during dacryocystorhinostomy : how useful is it ? Ophthalmology 2002 , 109(7) : 1214-1217 .

107- Karesh JW , Perman KI , Rodrigues MM :Dacryocystitis associated with malignant lymphoma of the lacrimal sac . Ophthalmology 1993, 100(5):669- 73 .

108- Baratz KH , Bartley GB , Campbell RJ , etal : An eyelash nidus for dacryoliths of the lacrimal excretory systems . Am J Ophthalmol 1991; 111: 624-627 .

109- Hawes MJ : The dacryolithiasis syndrome . Ophthal Plast Reconstr Surg 1988 ; 4: 87 -90 .

110- Kristinsson JK , Sigurdsson H : Lacrimal sac plugging caused by Aspergillus fumigatus . Acta-Ophthalmol-second 1998 , 76(2) :241-2 .

111- Speath GL : Nasolacrimal duct obstruction caused by topical epinephrine . Arch Ophthalmol 1967 ; 77 : 355 .

112- Groessi SA , Sires BS, Lemke BN : An anatomical basis for primary acquired nasolacrimal obstruction. Arch Ophthalmol 1997,115(1):71-4.

113- Camara JG, Bengzone AU: Nasolacrimal duct obstruction (2001) <htt://www.emedicine.com/oph/topic465.htm>accessed on 3/8/2005 .

114- Kloos RT, Duvuuri V, Jhiang SM , Cahill KV, etal : Nasolacrimal drainage system obsttroction from radioactive iodine therapy for thyroid carcinoma (NDSO) . J Clin Endocrinol Metab. 2002; 87 (12): 5817 -20.

115- Shepler TR , Sherman SI , Faustina MM , Busaidy NL , etal :

Nasolacrimal duct obstruction associated with radioactive iodine therapy for thyroid carcinoma . Ophthal-Plast-Reconstr-Surg 2003 ; 19(6) : 379-81 .

116- Alexandrakis G , Tse DT , Rosa RH , Johnson TE : Nasolacrimal duct obstruction and orbital cellulites associated with chronic intra-nasal cocaine Abuse . Arch Ophthalmol 1999 ; 117: 1617-1622 .

117- deBree R, Scheeren RA , Kummer A , Tiwari RM : Nasolacrimal ductobstruction caused by oncocytoma . Rhinology 2002 ; 40(30) : 165-7 .

118- Baredes S, Ludwin DB , Troublefield YL , Langer PD , etal : Adenocarcinoma ex-pleomorphic adenoma of the lacrimal sac and nasolacrimal duct: a case report. Laryngoscope 2003; 113(6):940-2.

119- Bajaj MS , Mahindraker A , Pushker N : Dentigerous cyst in the maxillary sinus : a rare cause of nasolacrimal duct obstruction . Orbit 2003 ; 22(4): 289-92 .

120- Cies WA , Baylis HI : Epiphora following rhinoplasty and Cald well-Luc Procedures . Ophthalmic Surg 1976 : 7-77 .

121- Gaynon IE : Lacrimal insufficiency : Kerato-conjunctivitis sicca an malfunction of the inferior turbinate . Am J Ophthalmol 1960 : 53-614.

122- Sekhar GC : Practical approach to a patient with epiphora . Indian J Opthalmol 1994 ; 42:157-61 .

123- Otaka I , Kyu N : A new surgical technique for management of conjunctivochalasis . Am J Opthalmol 2000 ; 385-7 .

124- Zippia RJ, Milder B : Lacrimal drainage function, part 1and 11 . the Jones fluorescein test . Am J Ophthalmol 1972 ; 74-154 .

125- Prabhasawat P , Tseng SC : Frequent association of delayed tear clearance in irritation . Br J Ophthalmol 1998 ; 82:666-75 .

126- Macri A , Rolando M , Pflugfelder S : A standard visual scale for evaluation of tear fluorescein clearance . Ophthalmology 2000 ; 107 : 1338-43 .

127- Camara JG , Santiago MD , Rodriguez RE , etal : The Micro-Reflux Test : a new test to evaluate nasolacrimal duct obstruction. Ophthalmolgy . 1999; 106(12):2319-21 .

128- Warmald PJ , Tsirbas A : Investigation and endoscopic treatment for functional and anatomical obstruction of the nasolacrimal duct system . Clin Otolaryngol Allied Sci 2004 ; 29 : 352-6 .

129- Georgiadis NS, Terzidou CD : Epiphora caused by conjunctivochalasis : treatment with transplantation of preserved human amniotic membrane . Cornea 2001; 20 : 619-21 .

129-

130- Meller D , Maskin SL , Pires RT , etal : Amniotic membrane transplantation for symptomatic conjunctivochalasis refractory to medical treatments . Cornea 2000; 19 : 796-803 .

131- Lehman SL: Tear-Duct obstruction and surgery (2005). <http://Kidsheath.Org/parent/system/surgical/tear duct obstruct surgery prt.htm>accessed on 3/8/2005 .

132- Overview dacryocystorhinostomy (DCR) (2005) http://www.oculoplastics co.UK/dacryocystorhinostomy overview. php>accessed on 3/8/2005 .

133- Fezza JP , Weseley RE , Kippenstein KA : The treatment of punctal and Canalicular stenosis in patients on systemic 5-FU . Ophthalmic Surg Lasers 1999 ; 30(2) : 105-108 .

134- McCord CDJr: Canalicular resection and reconstruction by canaliculostomy. Ophthalmic Surg 1980; 11: 440-5 .

135- Weber R, Draf W: Reconstruction of lacrimal ducts.

Larynorhinootologie 1993 ; 72 : 445-9 .

136- Steinkogler FJ : Canaliculocystostomy combining microsurgery and fibrin seating of the anastomosis . Ophthalmic Surg 1992 ; 23:485-8 .

137- Metaireau JP: Treatment of canalicular block . Eye 1988; 2(2) : 220-2.

138- Mauriello JA, Abdelsalam A: Use of a modified monocanalicular silicone stent in 33 eyelids . Ophthalmic Surg Laser 1996 ; 27: 929-34.

139- Patrinely JR , Anderson RI : A review of lacrimal drainage surgery . Ophthal Plast Reconstr Surg 1986 ; 2:97-102 .

140- Hurwitz JJ : New polypropylene tube to stent or bypass the lacrimal system . Can J Ophthalmol 1984 ; 19:261-5 .

141- Dutton JJ , Holck DE : Holmium laser canaliculoplasty . Ophthal Plast Reconstr Surg 1996 ;12: 211-7 .

142- Kuchar A , Novak P , Pieh S , Fink M : Endoscopic laser recanalisation of presaccal canalicular obstruction . Br J Ophthalmol 1999 ; 83(4): 443-447.

143- Meyer DR , Kersten RC , Kulwin DR , etal : Management of canalicular injury associated with eyelid burns . Arch Ophthalmol 1995 ; 113:900-3 .

144- Zapala J , Bartkowski AM, Bartkowski SB : Lacrimal drainage system obstruction : management and results obtained in 70 patients. J Craniomaxillofac Surg 1991 ; 7:167-72 .

145- Cahill KV , Burns JA : Management of epiphora in the presence of congenital punctal and canalicular atresia . Ophthal Plast Reconstr Surgery 1991 ; 7: 167-72 .

146- Sisler HA , Allarakhia L : A new ophthalmic microtrephine . Ophthalmic Surg 1990 ; 21:656-7 .

147- Liu D , Bosley TM : Silicone nasolacrimal intubation with mitomycin-C: a prospective, randomized, double masked study. Ophthalmology

2003 ; 110 : 306 – 10 .

148- Mauffray RO , Hassan AS , Elner VM : Double silicone intubation as treatment for persistent congenital nasolacrimal duct obstruction. Ophthal Plast Reconstr Surg 2004 ; 20 : 44-9 .

149- You YG , Choi HS, Kim SJ , etal : The results of endoscopic canaliculo- DCR with two sets of silicone intubation in canalicular obstruction . J Korean Ophthalmol Soc 2004 ; 45: 882-6 .

150- Ahmadi MA, Esmaeli B: Surgical treatment of canalicular stenosis in patients receiving Docetaxel weekly . Arch Ophthalmol 2001 ; 119:1802-1804 .

151- Birchansky LD , Nerad JA , Kersten RC , etal : Management of ongenital sac fistula . Arch Ophthalmol 1990 : 108-388 .

152- Wesley RE: Inferior turbinate fracture in the treatment of congenital nasolacrimal duct obstruction and congenital nasolacrimal duct anomaly . Ophthal plast Reconstr Surg 2001; 12: 31-33 .

153- Meyer DR: Surgical treatment of congenital lacrimal drainage system disorders . In Maurillo JA , ed unfavorable Results of Eyelid and lacrimal surgery: Prevention and Management . Boston: Butterworth Heinemann , 2000 ; 439-60 .

154- Skorin L : A clinical guide to lacrimal plumbing . Rev Optom 1993 ; 130(9) :75-7 .

155- Schwartz BA, Manley DR: Disorders of the lacrimal apparatus in infancy and childhood. In: Nelson LB, ed. Harley's Pediatric Ophthalmology. 4th ed. Philadelphia: WB. Saunders, 1998: 345-52.

156- Katowitz JA , Welsh MG : Timing of initial probing and irrigation in congenital nasolacrimal duct obstruction . Ophthalmology 1987, 94(6): 698-705 .

157- Lim CS , Martin F , Beckenham T : Nasolacrimal duct obstruction in children: Outcome of intubation. J AAPOS 2004; 8(5): 466-72 .

158- Camara JG, Bengzone AU: Nasolacrimal duct obstruction (2008) <htt://www.emedicine.com/oph/topic465.htm>accessed on 3/2/2008.

159- Yung MW and Lea S : Analysis of the results of surgical endoscopic dacryocystorhinostomy : effect of the level of obstruction . Br J Ophthalmol 2002 ; 86(7) : 792-794.

160- Ressiniotis T, Voros GM , Kostakis VT, Carrie S and Neoh C :Clinical outcome of endonasal KTP laser-assisted dacryocystorhinostomy . BMC Ophthalmol 2005 : 1471-2415 .

161- Boush GA , Papageorge A , Sacks E : Endonasal laser-associated dacryocytorhinostomy . Am J Rhinol 1999 ; 13: 371-374 .

162- You YA, Fang CT: Intra-operative mitomycin C in dacryocystorhinostomy. Ophthal Plast Reconstr Surg 2001; 17:115-119.

163- Nowinski TS, Flanagan JC, Mauriello J: Pediatric dacryocystorhinostomy. Arch Ophthalmol 1985; 103(8). <http://Archophtama-assnorg/egil content/Abstract/103/8/1226? maxtoshow =8 & HITS=108&hit...> accessed on 3/8/2005.

164- Seppa H, Grenman R , Hartikeinen J : Endonasal Co2-Nd:YAG laser dacryocystorhinostomy . Acta Ophthalmol Copenh 1994; 72:703-6 .

165- Hunter LR : Crawford tubes (with suture) secured with absorbable suture . J Pediatr Ophthalmol Strabismus 1995 : 32-197 .

166- Delcoigne C, Hennekes R: Probing and silicone intubation of the lacrimal system in adults. Bull-Soc-Belge-Ophthalmol 1994;245:63-5.

167- Angrist RC , Dortzbach RK : Silicone intubation for partial and total nasolacrimal duct obstruction in adults . Adv Ophthalmic Plast Reconstr Surg 1985 :1-51.

168- Katowitz JA: Pediatric oculoplastic surgery-google books <http://books.google .com/books ?-- > accessed on 2/5/2009 .

169- Harris GJ , Sakol PJ , Beatty RL : Relaxed skin tension line incision for dacryocystorhinostomy . Am J Ophthalmol 1989 : 108,742 .

170- Linberg JV, Anderson RL, Bumstead RM, etal : Study of intranasal ostium external dacryocystorhinostomy. Arch Ophthalmol 1982: 100,1758.

171- Merbs SL, Harris LL , Iwamoto MA , Iliff NT : Prevention of prolapsed silicone stents in lacrimal intubation using an intra-sac fixation suture . Arch Ophthalmol ; 117(8) : 1092-1095 .

172- Liao SL , Kao SCs , Tseng JHS , Chen MS , Hou PK : Results of intra –operative mitomycin C application in acryocystorhinostomy. Br J Ophthalmol 2000; 84 : 9036. .

173- Romanes GJ: Dacryocystorhinostomy clinical report of fifty cases. Br J Ophthalmol 1955; 39:237-40 .

174- Talks SJ, Hopkisson B: The frequency of entry into an ethmoidal sinus when performing a dacryocystorhinostomy. Eye 1996; 10:742-743 .

175- Welham RAN, Wule AE : Management of unsuccessful lacrimal surgery . Br J Ophthalmol 1987 ; 71:152-157 .

176- Walland MJ, Rose GE : Factors affecting the success rate of open lacrimal surgery . Br J Ophthalmol 1994 ; 78 : 888-89 .

177- Welham RAN , Henderson PH : Results of dacryocystorhinostomy analysis of causes for failure . Trans Ophthalmol Soc UK 1973 ; 93 : 601-609 .

178- Nik NA , Hurwitz JJ , Song HC : Mechanism of tear flow after dacryocystorhinostomy and Jones tube surgery . Arch Ophthalmol 1984:102-11.

179- Ezra E, Restori M, Mannor GE: Ultrasonic assessment of rhinostomy size following external dacryocystorhinostomy. Br J Ophthalmol

1998; 82:786- 9.

180- Wilcsek GA , Vose MJ , Francis IC , Sharma S and Coroneo MT : Acute angle closure glaucoma , following the use of intranasal cocaine during dacryocystorhinostomy . Br J Ophthalmol 2002; 86: 1312 .

181- Adenis JP, Ropert PY : Retro-caruncular approach to the medial orbit for DCR. Graefes-Arch-Clin-Exp-Ophthalmol 2003 ; 241(9): 725-9 .

182- Adenis JP , Ropert PY : Retro-canalicular approach to the medial orbit for DCR. Graefes-Arch-Clin-Exp-Ophthalmol 2003; 241(9): 725-9 .

183- Kumer EN : Technical note . Non surgical treatment of epiphora by balloon Dacryocystoplasty , the technique . Br-J-Radiol 1995; 68(814): 1116 – 8 .

184- Myer-Rusenberg HW, Emmerich KH, Luchtenberg M, Steinhauer J : Endoscopic laser dacryoplasty , Methodology and outcome after 3 months. Ophthalmology 1999; 96(5) : 332-4.

185- Shun-Shun GA: Endoscopic dacryocystorhinostomy: a personal technique – Eye 1998 ; 12 : 467-70 .

186- Berlin AT: Success rate of endoscopic laser assisted dacryocystorhinostomy. Ophthalmology 2000; 107: 4-5.

187- Yazici Z , Yazici B , Parlak M , etal : Treatment of obstructive epiphora in adults by balloon dacryocystoplasty . Br J Ophthalmol 1999 , 83 : 962-6 .

188- Kashkouli MB , Parvaresh M , Modarreszadeh M , etal : Factors affecting the success of external DCR . Orbit 2003 ; 22(4) :247-55 .

189- Caesar RH , McNab AA : EXT-DCR and local anaesthesia technique to measure to measure minimized blood loss . Ophthal-plast-Reconstr-Surg 2004 ; 20 (1) : 57-9 .

190- Lanciego C, Toledano N , Miguel SD , etal : Resolution of Epiphora with Nasolacrimal stents : Results of long-term Follow-up in

Multicenter prospective study . Journal of vascular and interventional Radiology 2003 ; 14: 1417-1425 .

191- Elwan S : A randomized study comparing DCR with and without excision of the posterior mucosal flap . Orbit 2003 ; 22(1) : 7-13 .

192- Tarbet KJ , Custer PL : EXT-DCR , surgical success , patient,s satisfaction and economic cost . Ophthalmology 1995 ; 102(7) : 1065-70 .

193- Yazici B , Meyer DR : Selective antibiotic use to prevent postoperative wound infection after external DCR . Ophthal-plas . Reconstr-Surg 2002 ;18(5) :331-5 .

194- Conway ST : Evaluation and management of functional NLD blockage, results of survey of the American society of ophthalmic plastic and reconstructive surgery – Ophthal – Plast –Reconstr –Surg 1994; 10(3):185 .

195- Mirza S , AL-Barmani A , Douglas SA : A retrospective comparison of endonasal laser DCR versus external DCR . Clin-Otolaryngol 2002; 27(5) : 347 – 51 .

196- Dolman PJ : Comparison of external DCR with non laser endonasal DCR . Ophthalmology 2003 ; 110(1) :78 -84.

197- Delaney YM , Khooshabeh R : External DCR for the treatment of acquired partial NLD obstruction in adults . Br. J . Ophthalmol 2002; 86(5) : 533 – 5 .

198- Malhorta R , Wrght M , Olver JM : A consideration of the time taken to do DCR surgery . Eye 2003 ; 17(6) : 694 – 6 .

199- Forster W, Peter A , Busse H : Lacrimal duct surgery in childhood, Retrospective study at Munster university . Ophthlmologe 1997; 94(8):587 – 90 .

200- Hartikainen J , Grenman R , Punkka P , Seppa H : Prospective

randomized comparison of EXT-DCR and endonasal laser DCR. Ophthalmology 1998 ; 105(6) : 1106-13 .

201- Woog JJ , Kennedy RH , custer PL , etal : Endonasal DCR , a report by the American Academy of ophthalmology . Ophthalmology 2001; 108(12) : 2369 -77 .

202- Beige B, Westlake W, Chang B, etal : Success rate and patient satisfaction after DCR surgery . Eye . 1998 ; 12 : 358 – 62 .

203- Becker BB: Dacryocystorhinostomy without flaps . Ophthalmic surg 1988 ; 81 : 1089 – 92 .

204- Fayet B, Bernard JA, Ritting P, etal: Internal transient palpebral inclusion following DCR . J-Fr-Ophthalmol 1994 ; 17(3) : 195 – 9.

Appendix

Preoperative Data collection Form

Serial No:

Name:

Age:

Sex: Male ☐ Female ☐

Symptoms present

- Epiphora Yes ☐ No ☐
-Recurrent dacryocystitis Yes ☐ No ☐
-Recurrent conjunctivitis Yes ☐ No ☐
-Painfull swelling medial canthus Yes ☐ No ☐
-Blood stained tear Yes ☐ No ☐
-Epistaxis Yes ☐ No ☐

Past ocular history

-Previous DCR Yes ☐ No ☐
-Past history of trauma Yes ☐ No ☐
-Previous lid surgery Yes ☐ No ☐
-Antiglaucoma medications Yes ☐ No ☐
-Use of other topical medications Yes ☐ No ☐

If Yes Types of medicine:

-

-

Past medical history

-Lymphoma	Yes ☐	No ☐
-Wegener granulomatosis	Yes ☐	No ☐
-Sarcoidosis	Yes ☐	No ☐
-Sinus histiocytosis	Yes ☐	No ☐
-Scleroderma	Yes ☐	No ☐
-Previous radiation to medial canthus	Yes ☐	No ☐
-Systemic chemotherapy with 5-FU	Yes ☐	No ☐
-Parasitic infection (ascaris lumbricoides)	Yes ☐	No ☐
-Facial trauma	Yes ☐	No ☐
-Previous nasal or sinus surgery	Yes ☐	No ☐

Signs present:

Ocular examination

-Over flow of tears	Yes ☐	No ☐
-Fluctuant mass on the lacrimal sac area	Yes ☐	No ☐
-Presence of fistula	Yes ☐	No ☐
- Eye discharge:		
Mucoid	Yes ☐	No ☐
Purulent	Yes ☐	No ☐
-Regurgitation test with mucoid reflux	Yes ☐	No ☐
-Lacrimal irrigation	+ve	-ve
-Fluorescein dye disappearance test	+ve	-ve

Slit lamp findings

-Tear meniscus height more than 2mm Yes ☐ No ☐

-Expression of concertions or pus from punctum Yes ☐ No ☐

ENT examination

-Nasal mucosal atrophy Yes ☐ No ☐

-Nasal foreign bodies Yes ☐ No ☐

-Deviated nasal septum Yes ☐ No ☐

-Sinusitis Yes ☐ No ☐

-Mucocele Yes ☐ No ☐

-Nasal tumour Yes ☐ No ☐

-Pharyngeal tumour Yes ☐ No ☐

<u>Lab findings</u>

-Gram stain for lacrimal discharge +ve -ve

If +ve : causative organism is:

-

Sensitive to:

Intra-operative data collection form

Serial No:

Name:

Age:

Sex:

Subcutaneous injection of adrenaline and xylocaine Yes ☐ No ☐

Nasal packing with adrenaline and xylocaine Yes ☐ No ☐

Skin incision:

Site - 11mm from the inner canthus ☐

- Towords the dorsum of the nose ☐

- Towords the inner canthus ☐

Size -20mm (2cm)

->20mm ☐

-<20mm ☐

Condition of the sac:

-Normal size Yes ☐ No ☐

-Large due to mucocele Yes ☐ No ☐

-Small or shrunken due to inflammation Yes ☐ No ☐

Osteotomy

-Site

-Size: - 1.5 cm ☐

->1.5cm ☐

-<1.5cm ☐

Position of ethmoidal sinuses

-Normal position (not exposed) Yes ☐ No ☐

-Anterior position (exposed) Yes ☐ No ☐

Intra-nasal pathology:

-Normal nasal mucosa Yes ☐ No ☐

-Atrophy of nasal mucosa Yes ☐ No ☐

-Intra nasal tumour Yes ☐ No ☐

Lacrimal sac and nasal mucosal flaps:

-Available Yes ☐ No ☐

- Suturing of flaps:

Anterior and posterior flaps Yes ☐ No ☐

Anterior flaps only Yes ☐ No ☐

Posterior flaps only Yes ☐ No ☐

Not sutured Yes ☐ No ☐

- Suspension of flaps Yes ☐ No ☐

Intra-operative bleeding Yes ☐ No ☐

If yes:

Mild ☐

Moderate ☐

Severe ☐

Wound closure:

Type -Vicryl ☐

-Silk ☐

-Prollen ☐

Cuticale ☐ Subcutical ☐

Interrupted ☐ Contineous ☐

Post-operative data collection form

Serial No:

Name:

Age:

Sex:

Second day after operation

Pain	Yes ☐	No ☐
Brusis	Yes ☐	No ☐
Haematoma	Yes ☐	No ☐
Bleeding	Yes ☐	No ☐
Tubes in place	Yes ☐	No ☐

One week after operation

Wound infection	Yes ☐	No ☐
Wound healing	Yes ☐	No ☐
Tubes in place	Yes ☐	No ☐

Two months after operation

Epiphora	Yes ☐	No ☐
Skin scarring	Yes ☐	No ☐
Infection	Yes ☐	No ☐
Punctal tearing	Yes ☐	No ☐

Six months after operation

Symptoms present:

-
-
-

Syringing test: +ve ☐ -ve ☐

Fluorescin dye disappearance test: +ve ☐ -ve ☐

Tube removal at:

- 3 months
- 6 months
- > 6 months

Chi-Square = P value

Q2 = chronic dacryocystitis

Q7 = previous DCR

Q8 = previous trauma

Q34 = deviated septum

Q35 = sinusitis

Q40 = subcutaneous injection of adrenaline and xylocaine

Q47 = osteotomy size

Q55 = suturing of the anterior flaps

Q58 = suspension of the anterior flaps

Q59 = intra-operative bleeding

Q66 = wound infection

Q73 = success rate & failure rate